Part No. 12190SL (Rev. A)

Service Manual

(Models 04530 and 04540)

Greensmaster® TriFlex™ 3320/3420

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing and repair of major systems and components on the Greensmaster TriFlex Hybrid 3320 and 3420.

REFER TO THE TRACTION UNIT AND CUTTING UNIT OPERATOR'S MANUALS FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. For reference, insert a copy of the Operator's Manuals and Parts Catalogs for your machine into Chapter 2 of this service manual. Additional copies of the Operator's Manuals and Parts Catalog are available on the internet at www.Toro.com.

The Toro Company reserves the right to change product specifications or this publication without notice.

⚠

This safety symbol means DANGER, WARNING or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.

NOTE: A **NOTE** will give general information about the correct operation, maintenance, service, testing or repair of the machine.

IMPORTANT: The IMPORTANT notice will give important instructions which must be followed to prevent damage to systems or components on the machine.

Greensmaster 3320

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Chapter 1

Safety

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General Safety Instructions

Greensmaster TriFlex Hybrid 3320 and 3420 machines have been tested and certified by TORO for compliance with existing safety standards and specifications. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

⚠ WARNING

To reduce the potential for injury or death, comply with the following safety instructions.

Before Operating

1. Review and understand the contents of the Operator's Manuals and Operator's DVD before starting and operating the vehicle. Become familiar with the controls and know how to stop the vehicle and engine quickly. Additional copies of the Operator's Manual are available on the internet at www.Toro.com.

2. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective, illegible or damaged, repair or replace it before operating the machine. Also tighten any loose nuts, bolts or screws to ensure machine is in safe operating condition.

3. Assure interlock switches are adjusted correctly so engine cannot be started unless functional control lever is in the neutral position.

4. Since fuel is flammable, handle it carefully:

   A. Use an approved fuel container.

   B. Do not remove fuel tank cap while engine is hot or running.

   C. Do not smoke while handling fuel.

   D. Fill fuel tank outdoors and only to within an inch of the top of the tank, not the filler neck. Do not overfill the fuel tank.

   E. Wipe up any spilled fuel.

While Operating

1. Sit on the seat when starting and operating the machine.

2. Before starting the engine:

    A. Sit on the operator seat.

    B. Verify that functional control lever is in neutral.

    C. Verify that parking brake is applied.

    D. Proceed to start engine.

    E. After engine is started, release parking brake and keep foot off traction pedal. Machine must not move. If movement is evident, the traction pedal linkage is adjusted incorrectly; therefore, shut engine off and adjust traction pedal linkage until machine does not move when traction pedal is released.

3. Do not run engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could possibly be deadly.

4. Do not touch engine, exhaust system components or radiator (if equipped) while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.

5. Before getting off the seat:

    A. Make sure cutting units are disengaged and have stopped rotating.

    B. Verify that functional control lever is in neutral.

    C. Apply the parking brake.

    D. Stop the engine and remove key from ignition switch.

    E. Toro recommends that anytime the machine is parked (short or long term), the cutting units should be lowered to the ground. This relieves pressure from the hydraulic lift circuit and eliminates the risk of cutting units accidentally lowering to the ground.

    F. Do not park the machine on slopes unless wheels are chocked or blocked.

Maintenance and Service

1. The Traction Unit and Cutting Unit Operator's Manuals provide information regarding the operation, general maintenance and maintenance intervals for your Greensmaster machine. Refer to these publications for additional information when servicing the machine.

2. Before servicing or making adjustments, lower cutting units, place functional control lever in the neutral position, stop engine, apply parking brake and remove key from the ignition switch.

3. Make sure machine is in safe operating condition by keeping all nuts, bolts and screws tight.

4. Never store the machine or fuel container inside where there is an open flame, such as near a water heater or furnace.

5. Make sure all hydraulic line connectors are tight and all hydraulic hoses and lines are in good condition before applying pressure to the hydraulic system.

6. Keep body and hands away from pin hole leaks in hydraulic lines that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks. Hydraulic fluid escaping under pressure can penetrate skin and cause injury. Fluid accidentally injected into the skin must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.

7. Before disconnecting or performing any work on the hydraulic system, all pressure in system must be relieved by stopping engine and lowering cutting units to the ground.

8. If major repairs are ever needed or assistance is desired, contact an Authorized Toro Distributor.

9. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt. Clean protective screen on machine frequently.

10. If engine must be running to perform maintenance or an adjustment, keep hands, feet, clothing and other parts of the body away from cutting units and other moving parts. Keep bystanders away.

11. Do not overspeed the engine by changing governor setting. To assure safety and accuracy, check maximum engine speed.

12. Shut engine off before checking or adding oil to the engine crankcase.

13. Disconnect battery before servicing the machine. Disconnect negative battery cable first and positive cable last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery. Reconnect positive battery cable first and negative cable last.

14. Before installing, removing or working on the cutting units, disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers. The couplers are located at the base of the rollover bar on the left side of the traction unit. Connect the couplers together before operating the machine.

15. Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing. Protect your face, eyes and clothing when working with a battery.

16. Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

17. When welding on machine, disconnect both battery cables to prevent damage to machine electronic equipment. Disconnect negative battery cable first and positive cable last. Also, disconnect the wire harness connector from the TEC controller and the alternator connector(s). This will prevent damage to the electrical system of your Greensmaster.

18. At the time of manufacture, the machine conformed to the safety standards for riding mowers. To assure optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in non-conformance with the safety standards and the warranty may be voided.

19. When changing attachments, tires or performing other service, use correct jacks and supports. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use appropriate jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury (see Jacking Instructions in this chapter).

Jacking Instructions

CAUTION

When changing attachments, tires or performing other service, use correct jacks and supports. Make sure machine is parked on a solid, level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

Front End Jacking

1. Apply parking brake and chock rear tire to prevent the machine from moving.

2. Position jack securely under the frame jacking point:

   A. The left side jacking point is the frame channel under the step behind the LH front wheel (Fig. 1).

   B. The right side jacking point is the frame bracket behind the RH front wheel (Fig. 2).

3. Jack front of machine off the ground.

4. Position appropriate jack stands under the frame as close to the wheel as possible to support the machine.

Rear End Jacking

1. Apply parking brake and chock both front tires to prevent the machine from moving.

2. Place jack securely under the rear jacking point on the rear steering fork (Fig. 3).

3. Jack rear of machine off the ground.

4. Position appropriate jack stands under the frame to support the machine.

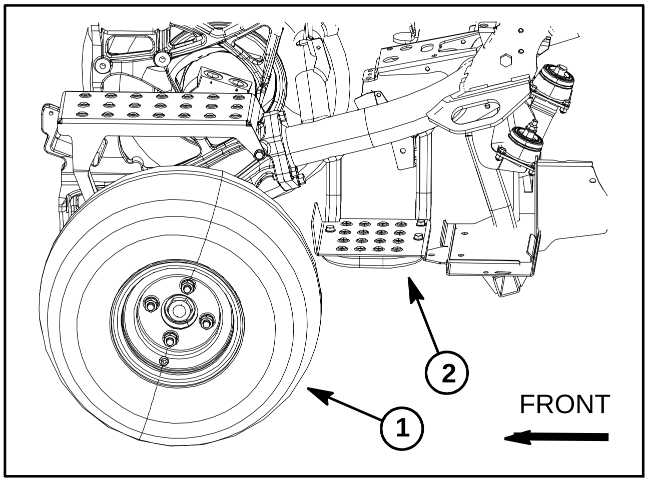

Figure 1

1. **LH front wheel**
2. **Jacking point**

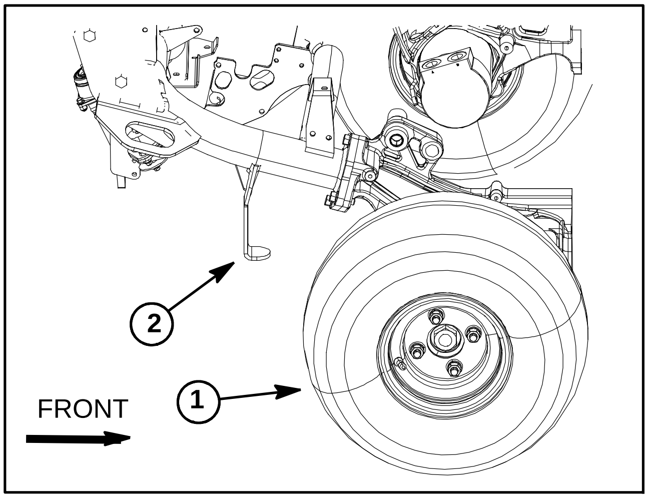

Figure 2

1. **RH front wheel**
2. **Jacking point**

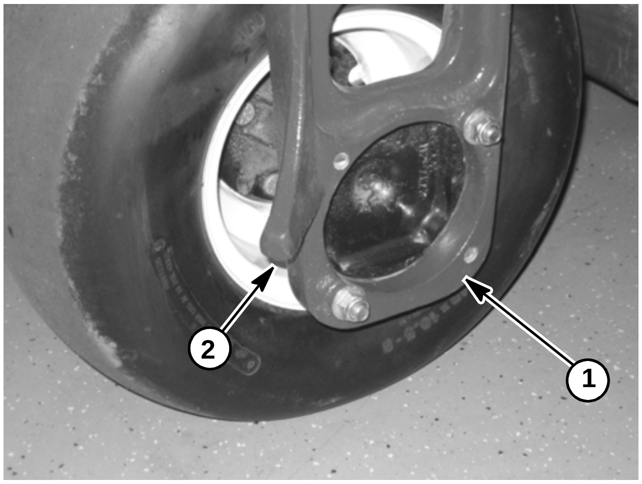

Figure 3

1. **Rear steering fork**
2. **Rear jacking point**

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the traction unit and the cutting units of Greensmaster TriFlex Hybrid 3320 and 3420 machines. If any decal becomes illegible or damaged, install a new decal. Part numbers are listed in your Parts Catalog and Operator's Manual. Order replacement decals from your Authorized Toro Distributor.

Product Records and Maintenance

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Product Records

Insert a copy of the Traction Unit and Cutting Unit Operator's Manuals and Parts Catalog for your Greensmaster at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your machine, insert the Installation Instructions, Operator's Manuals and Parts Catalogs for those options at the end of this chapter.

Maintenance

Maintenance procedures and recommended service intervals for your Greensmaster are covered in the Traction Unit Operator's Manual. Maintenance procedures and recommended service intervals for the Greensmaster Cutting Units are covered in the Cutting Unit Operator's Manual. Refer to these publications when performing regular equipment maintenance. Refer to the Engine Operator's Manual for additional engine specific maintenance procedures.

Equivalents and Conversions

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm
1/64	0.015625	0.397	33/64	0.515625	13.097
1/32	0.03125	0.794	17/32	0.53125	13.494
3/64	0.046875	1.191	35/64	0.546875	13.891
1/16	0.0625	1.588	9/16	0.5625	14.288
5/64	0.078125	1.984	37/64	0.578125	14.684
3/32	0.09375	2.381	19/32	0.59375	15.081
7/64	0.109275	2.778	39/64	0.609375	15.478
1/8	0.1250	3.175	**5/8**	0.6250	15.875
9/64	0.140625	3.572	41/64	0.640625	16.272
5/32	0.15625	3.969	21/32	0.65625	16.669
11/64	0.171875	4.366	43/64	0.671875	17.066
3/16	0.1875	4.762	11/16	0.6875	17.462
13/64	0.203125	5.159	45/64	0.703125	17.859
7/32	0.21875	5.556	23/32	0.71875	18.256
15/64	0.234375	5.953	47/64	0.734375	18.653
1/4	0.2500	6.350	**3/4**	0.7500	19.050
17/64	0.265625	6.747	49/64	0.765625	19.447
9/32	0.28125	7.144	25/32	0.78125	19.844
19/64	0.296875	7.541	51/64	0.796875	20.241
5/16	0.3125	7.938	13/16	0.8125	20.638
21/64	0.328125	8.334	53/64	0.828125	21.034
11/32	0.34375	8.731	27/32	0.84375	21.431
23/64	0.359375	9.128	55/64	0.859375	21.828
3/8	0.3750	9.525	**7/8**	0.8750	22.225
25/64	0.390625	9.922	57/64	0.890625	22.622
13/32	0.40625	10.319	29/32	0.90625	23.019
27/64	0.421875	10.716	59/64	0.921875	23.416
7/16	0.4375	11.112	15/16	0.9375	23.812
29/64	0.453125	11.509	61/64	0.953125	24.209
15/32	0.46875	11.906	31/32	0.96875	24.606
31/64	0.484375	12.303	63/64	0.984375	25.003
1/2	0.5000	12.700	**1**	1.000	25.400

1 mm = 0.03937 in.

0.001 in. = 0.0254 mm

U.S.to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
	Pounds/Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subract 32° 2. Multiply by 5/9

Torque Specifications

Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

These Torque Specifications for the installation and tightening of fasteners shall apply to all fasteners which do not have a specific requirement identified in this Service Manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (e.g. Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature, hardness of the surface underneath the fastener's head or similar condition which affects the installation.

As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification

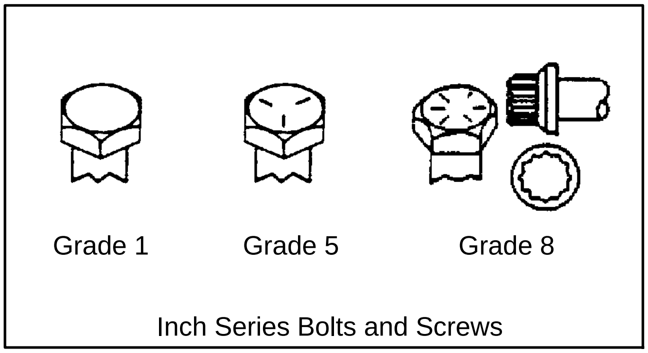

Figure 1

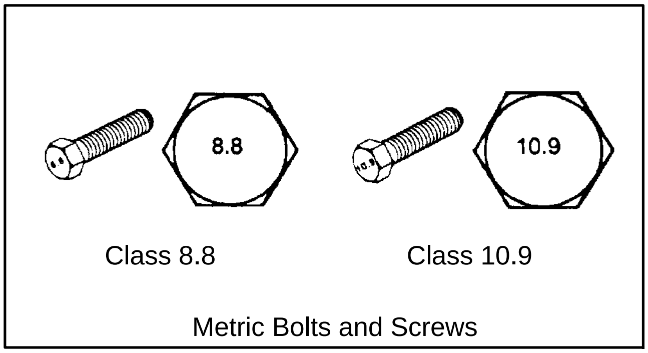

Figure 2

Using a Torque Wrench with an Offset Wrench

Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench calibration due to the effective change of torque wrench length. When using a torque wrench with an offset wrench, multiply the listed torque recommendation by the calculated torque conversion factor (Fig. 3) to determine proper tightening torque. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed torque recommendation.

Example: The measured effective length of the torque wrench (distance from the center of the handle to the center of the square drive) is 18".

The measured effective length of the torque wrench with the offset wrench installed (distance from the center of the handle to the center of the offset wrench) is 19".

The calculated torque conversion factor for this torque wrench with this offset wrench would be 18 / 19 = 0.947.

If the listed torque recommendation for a fastener is from 76 to 94 ft-lb, the proper torque when using this torque wrench with an offset wrench would be from 72 to 89 ft-lb.

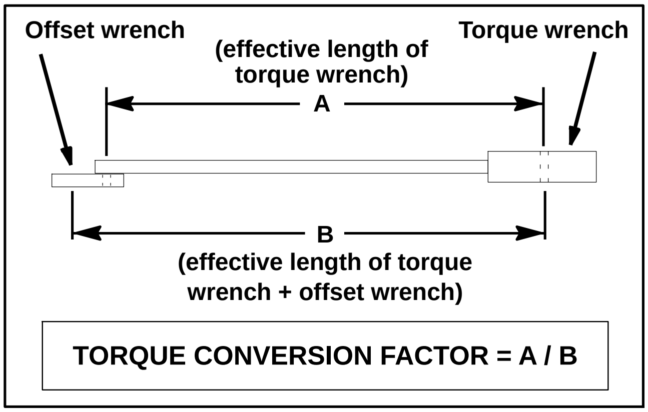
Offset wrench
Torque wrench
(effective length of torque wrench)
A
B
(effective length of torque wrench + offset wrench)
TORQUE CONVERSION FACTOR = A / B

Figure 3

Standard Torque for Dry, Zinc Plated and Steel Fasteners (Inch Series)

Thread Size	Grade 1, 5 & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in-lb	**in-lb**	**N-cm**	**in-lb**	**N-cm**	**in-lb**	**N-cm**
# 6 – 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	170 ± 20	23 ± 2	260 ± 20
# 6 – 40 UNF				17 ± 2	190 ± 20	25 ± 2	280 ± 20
# 8 – 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	330 ± 30	41 ± 4	460 ± 45
# 8 – 36 UNF				31 ± 3	350 ± 30	43 ± 4	485 ± 45
# 10 – 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 4	475 ± 45	60 ± 6	675 ± 70
# 10 – 32 UNF				48 ± 4	540 ± 45	68 ± 6	765 ± 70
1/4 – 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1125 ± 100	140 ± 15	1580 ± 170
1/4 – 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 10	1300 ± 100	160 ± 15	1800 ± 170
5/16 – 18 UNC	115 ± 15	105 ± 17	1186 ± 169	200 ± 25	2250 ± 280	300 ± 30	3390 ± 340
5/16 – 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2540 ± 280	325 ± 30	3670 ± 340
	ft-lb	**ft-lb**	**N-m**	**ft-lb**	**N-m**	**ft-lb**	**N-m**
3/8 – 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 4	58 ± 5
3/8 – 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 3	47 ± 4	50 ± 4	68 ± 5
7/16 – 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16 – 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 5	75 ± 7	77 ± 7	104 ± 9
1/2 – 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 10	142 ± 14
1/2 – 20 UNF	32 ± 3	53 ± 7	72 ± 9	85 ± 8	115 ± 11	120 ± 10	163 ± 14
5/8 – 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 20	285 ± 27
5/8 – 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 15	230 ± 20	240 ± 20	325 ± 27
3/4 – 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 25	359 ± 34	375 ± 35	508 ± 47
3/4 – 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 25	407 ± 34	420 ± 35	569 ± 47
7/8 – 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 – 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 45	644 ± 61	660 ± 60	895 ± 81

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite or thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

Standard Torque for Dry, Zinc Plated and Steel Fasteners (Metric Fasteners)

Thread Size	Class 8.8 Bolts, Screws and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)	
M5 X 0.8	57 ± 5 in–lb	640 ± 60 N–cm	78 ± 7 in–lb	885 ± 80 N–cm
M6 X 1.0	96 ± 9 in–lb	1018 ± 100 N–cm	133 ± 13 in–lb	1500 ± 150 N–cm
M8 X 1.25	19 ± 2 ft–lb	26 ± 3 N–m	27 ± 2 ft–lb	36 ± 3 N–m
M10 X 1.5	38 ± 4 ft–lb	52 ± 5 N–m	53 ± 5 ft–lb	72 ± 7 N–m
M12 X 1.75	66 ± 7 ft–lb	90 ± 10 N–m	92 ± 9 ft–lb	125 ± 12 N–m
M16 X 2.0	166 ± 15 ft–lb	225 ± 20 N–m	229 ± 22 ft–lb	310 ± 30 N–m
M20 X 2.5	325 ± 33 ft–lb	440 ± 45 N–m	450 ± 37 ft–lb	610 ± 50 N–m

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite or thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

Thread Size	Recommended Torque	
	Square Head	Hex Socket
1/4 – 20 UNC	140 ± 20 in–lb	73 ± 12 in–lb
5/16 – 18 UNC	215 ± 35 in–lb	145 ± 20 in–lb
3/8 – 16 UNC	35 ± 10 ft–lb	18 ± 3 ft–lb
1/2 – 13 UNC	75 ± 15 ft–lb	50 ± 10 ft–lb

Wheel Bolts and Lug Nuts

Thread Size	Recommended Torque**	
7/16 – 20 UNF Grade 5	65 ± 10 ft–lb	88 ± 14 N–m
1/2 – 20 UNF Grade 5	80 ± 10 ft–lb	108 ± 14 N–m
M12 X 1.25 Class 8.8	80 ± 10 ft–lb	108 ± 14 N–m
M12 X 1.5 Class 8.8	80 ± 10 ft–lb	108 ± 14 N–m

** For steel wheels and non–lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

Type 1, Type 23 or Type F	
Thread Size	Baseline Torque*
No. 6 – 32 UNC	20 ± 5 in–lb
No. 8 – 32 UNC	30 ± 5 in–lb
No. 10 – 24 UNC	38 ± 7 in–lb
1/4 – 20 UNC	85 ± 15 in–lb
5/16 – 18 UNC	110 ± 20 in–lb
3/8 – 16 UNC	200 ± 100 in–lb

Thread Cutting Screws (Zinc Plated Steel)

Thread Size	Threads per Inch		Baseline Torque*
	Type A	Type B	
No. 6	18	20	20 ± 5 in–lb
No. 8	15	18	30 ± 5 in–lb
No. 10	12	16	38 ± 7 in–lb
No. 12	11	14	85 ± 15 in–lb

* Hole size, material strength, material thickness and finish must be considered when determining specific torque values. All torque values are based on non–lubricated fasteners.

Conversion Factors

in–lb X 11.2985 = N–cm

ft–lb X 1.3558 = N–m

N–cm X 0.08851 = in–lb

N–m X 0.7376 = ft–lb

Chapter 3

Gasoline Engine

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BRIGGS & STRATTON VANGUARD V–TWIN OHV REPAIR MANUAL

Specifications

Item	Description
Make / Designation	Briggs and Stratton, 4–cycle, V–Twin Cylinder, OHV, Air Cooled, Gasoline Engine – Model 385447
Bore x Stroke	2.97” x 2.76” (75.5 mm x 70 mm)
Total Displacement	38.3 in^3 (627 cc)
Governor	Mechanical Governor
Carburetor	Float Feed, Two Barrel
Fuel Pump	Pulsating Crankcase Vacuum
Fuel	Unleaded, regular grade gasoline
Fuel Tank Capacity	6.0 U.S. gallons (22.7 liters)
Low Idle (no load)	1650 ± 100 RPM
High Idle (no load)	2920 ± 50 RPM
Lubrication System	Pressure Lubrication, Gear Driven Geroter Oil Pump
Engine Oil	See Operator’s Manual
Crankcase Oil Capacity	1.75 U.S. quarts (1.65 liters) with new filter
Ignition System	Flywheel magneto, twin electronic armatures
Spark Plugs	Champion RC 14YC (or equivalent)
Spark Plug Gap	0.030” (0.76 mm)
Alternator	20/50 Amp
Dry Weight (approximate)	85 lb (39 kg)

General Information

Information about specifications, maintenance, troubleshooting, testing and repair of the gasoline engine used in the Greensmaster TriFlex Hybrid 3320 is included in this chapter and the Briggs & Stratton Vanguard V–Twin OHV Repair Manual.

Most engine repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Briggs & Stratton Repair Manual. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

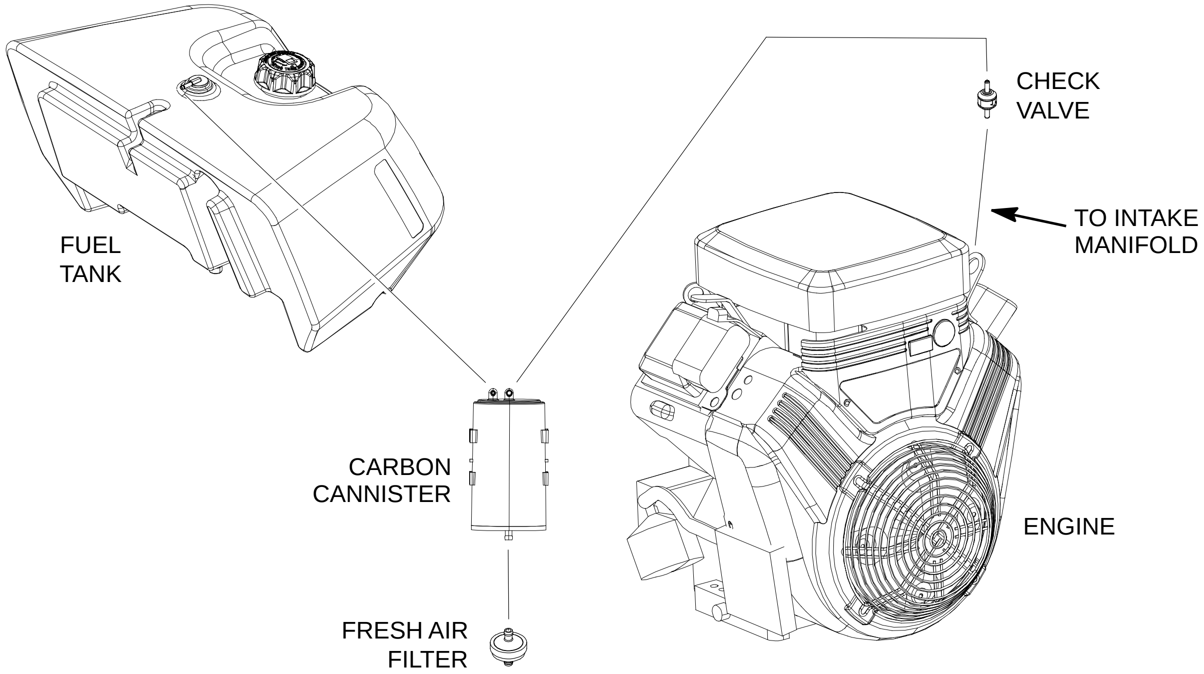
Service and repair parts for Briggs & Stratton Vanguard V-Twin OHV engines are supplied through your local local Toro distributor. If no parts list is available, be sure to provide your distributor with the Toro model and serial number along with the engine model and serial number.

Operator’s Manual

The Traction Unit Operator’s Manual provides information regarding the operation, general maintenance and maintenance intervals for your Greensmaster machine. Refer to the Operator’s Manual for additional information when servicing the machine.

Fuel Evaporative Control System

SERIAL NUMBER BELOW 312000000


CHECK VALVE
TO INTAKE MANIFOLD
FUEL TANK
CARBON CANNISTER
ENGINE
FRESH AIR FILTER

SERIAL NUMBER ABOVE 312000000

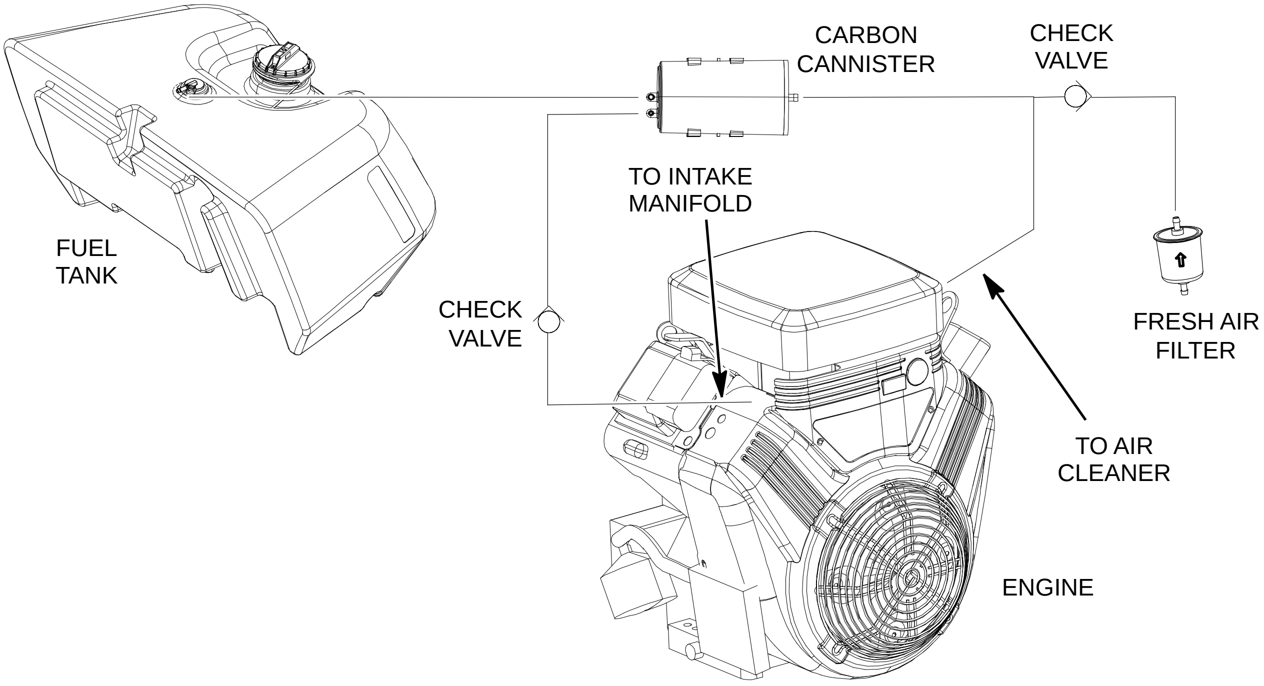

CARBON CANNISTER
CHECK VALVE
TO INTAKE MANIFOLD
FUEL TANK
CHECK VALVE
FRESH AIR FILTER
TO AIR CLEANER
ENGINE

Figure 1

The function of the fuel evaporative control system is to collect and store evaporative emissions from the fuel tank and engine. The evaporate control system used on Greensmaster 3320 machines uses a carbon cannister to collect these evaporative emissions. Fuel vapors from the fuel tank are vented to the canister when the engine is not running. Vapors from the canister are consumed when the engine is running.

The fuel tank on Greensmaster 3320 machines uses a non–vented fuel cap. To connect the tank to the evaporative control system, a fuel vent valve is positioned in the top of the tank that allows tank venting through the carbon cannister.

NOTE: If there is restriction in the fresh air filter, the carbon cannister or the fuel vent valve, the fuel tank may distort due to venting issues. If the fuel tank returns to it's normal shape when the fuel cap is removed, restriction in the evaporative control system is likely.

Components used in the evaporative control system on Greensmaster 3320 machines changed at serial number 312000000. Figure 1 illustrates the components used in the evaporative control system.

Machines With Serial Number Below 312000000

On machines with serial number below 312000000, the carbon canister is mounted under the fuel tank mount plate. One fitting at the engine intake manifold is used to connect the evaporative system to the engine. These machines use an inline check valve between the carbon cannister and the engine intake manifold fitting.

Machines With Serial Number Above 312000000

On machines with serial number above 312000000, the carbon canister is mounted between the hydraulic reservoir and leak detector tank. The evaporative system includes two (2) connections to the engine: one to the intake manifold and the second to the air cleaner base. Venting hose assemblies include a check valve in two (2) locations as shown in Figure 1.

NOTE: The check valves used on machines with serial number above 312000000 are included as a component of the hose assembly and are not available as a separate part. To ensure proper operation of check valves, do not attempt to remove them from the hose assembly. If either of these hose assemblies are removed, make sure that they are correctly installed to insure correct operation of the evaporative control system.

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Adjustments

Choke Cable Adjustment

1. Park machine on a level surface, disengage and lower cutting units, move functional control lever to neutral (N), engage parking brake, stop the engine and remove the key from the ignition switch. Wait for all machine movement to stop.

2. Remove air cleaner cover and air filter from engine.

3. Move choke control on control panel while watching choke plate in carburetor.

   A. Choke plate should be fully open when choke control is pushed in.

   B. Choke plate should be fully closed when choke control is pulled out.

4. If cable adjustment is needed, loosen cap screw and nut that secure choke cable clamp. Reposition cable to allow correct choke operation. Secure choke cable clamp.

5. After adjustment, move choke control several times to make sure that choke operation is correct.

6. Assemble air cleaner.

Throttle Cable Adjustment

1. Park machine on a level surface, disengage and lower cutting units, move functional control lever to neutral (N), engage parking brake, stop the engine and remove the key from the ignition switch. Wait for all machine movement to stop.

2. Adjust throttle control on console to the fast position. Inspect governor lever on engine to make sure that lever is fully rotated and against stop on governor control.

3. If throttle cable adjustment is needed (Fig. 2):

   A. Loosen cap screw that secures throttle cable clamp on engine bracket.

   B. Reposition cable to allow correct governor rotation.

   C. Tighten screw to secure throttle cable clamp.

4. After adjustment, move throttle control on console from low idle to high idle to make sure that cable travel is correct.

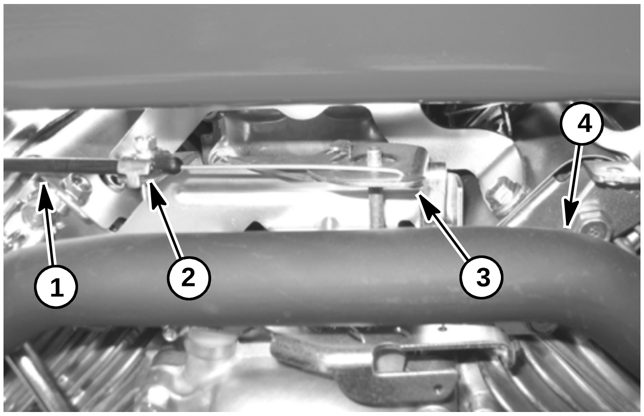

Figure 2

1. Throttle cable
2. Cable clamp
3. Governor control lever
4. Exhaust manifold

Service and Repairs

Fuel Evaporative Control System (Serial Number Below 312000000)

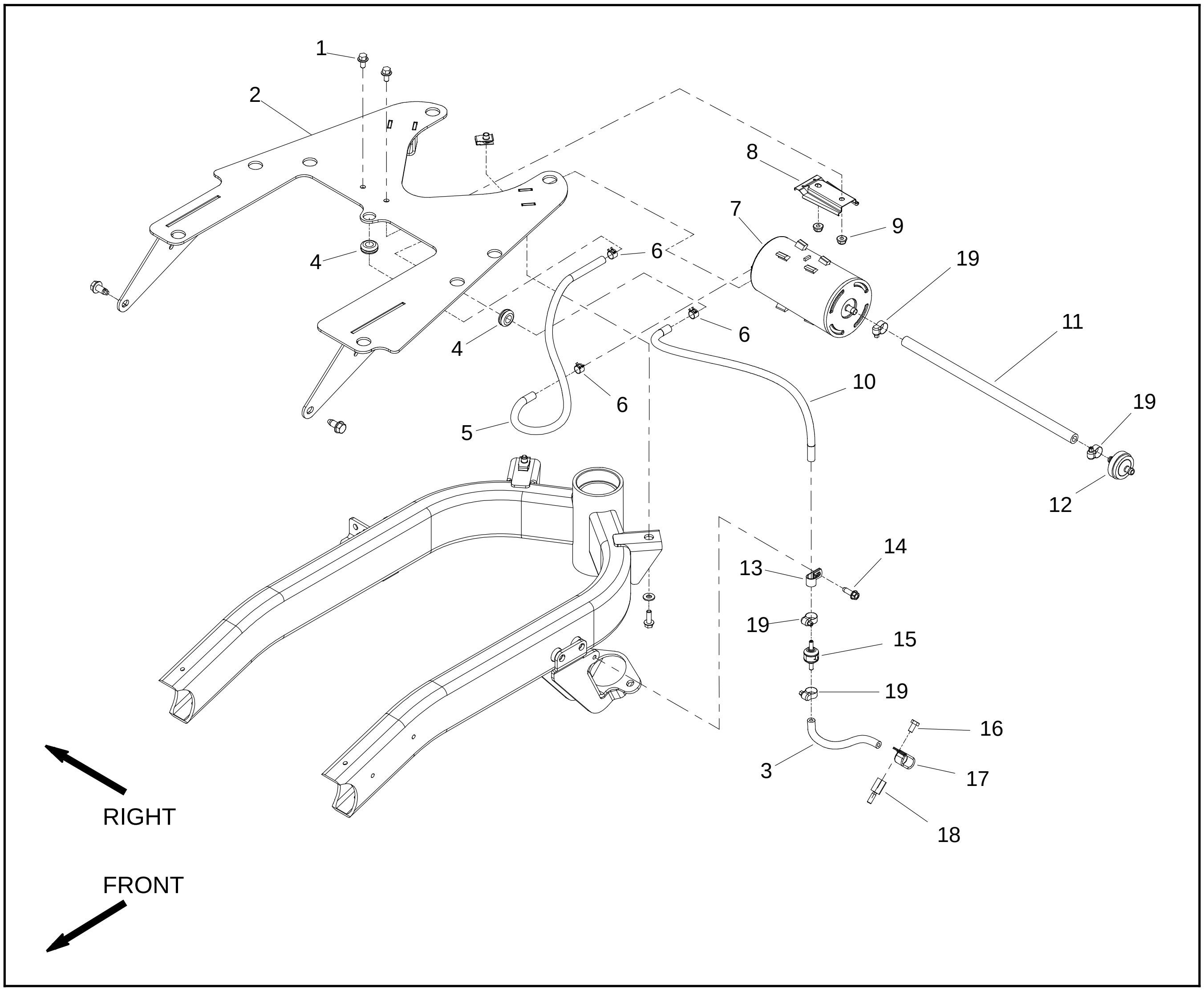

Figure 3

1. **Flange head screw (2 used)**
2. **Tank mount plate**
3. **Fuel hose**
4. **Grommet (2 used)**
5. **Fuel hose (cannister to tank vent)**
6. **Hose clamp (3 used)**
7. **Carbon canister**
8. **Bracket**
9. **Flange nut (2 used)**
10. **Fuel hose (cannister to engine)**
11. **Fuel hose**
12. **Fresh air filter**
13. **R-clamp**
14. **Washer head screw**
15. **Check valve**
16. **Cap screw**
17. **R-clamp**
18. **Spacer screw (attached to engine)**
19. **Worm clamp (4 used)**

The function of the fuel evaporative control system is to collect and store evaporative emissions from the fuel tank and engine. On machines with serial number below 312000000, a carbon canister mounted under the fuel tank mount plate is used to collect the fuel vapors. Fuel vapors from the engine and fuel tank are vented to the canister when the engine is not running. Vapors from the canister are consumed when the engine is running.

Removal (Fig. 3)

1. Park machine on a level surface, disengage and lower cutting units, move functional control lever to neutral (N), engage parking brake, stop the engine and remove the key from the ignition switch. Wait for all machine movement to stop.

DANGER

Gasoline is flammable. Use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running or in an enclosed area. Always fill fuel tank outside and wipe up any spilled fuel before starting the engine. Store fuel in a clean, safety-approved container and keep the cap in place. Use gasoline for the engine only; not for any other purpose.

2. Access the carbon cannister under the fuel tank and between the rear frame sections. If necessary, raise and support tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) to reach the cannister (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 – Chassis).

3. Inspect carbon cannister for damage or obvious leaks. A damaged or leaking cannister should be replaced.

4. Remove components as needed using Figure 3 as a guide.

   A. If check valve (item 15) is removed, note direction of arrow on valve body for assembly purposes.

Installation (Fig. 3)

1. Install all removed components using Figure 3 as a guide.

   A. If check valve (item 15) was removed, make sure that arrow on valve body points toward engine.

   B. Make sure that fuel hoses are not kinked after installation. Also, secure all hoses with hose clamps.

2. If tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) was raised to access the cannister, lower and secure tank mount plate assembly (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 – Chassis).

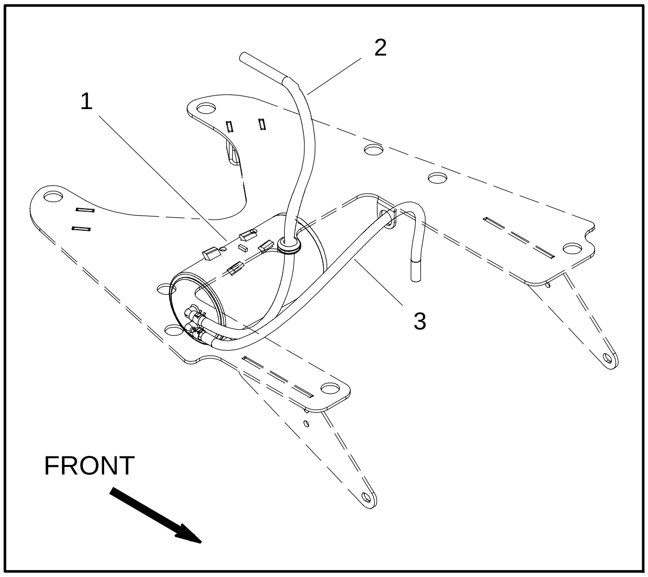

Figure 4

1. **Carbon cannister**
2. **Hose to tank vent**
3. **Hose to engine**

Fuel Evaporative Control System (Serial Number Above 312000000)

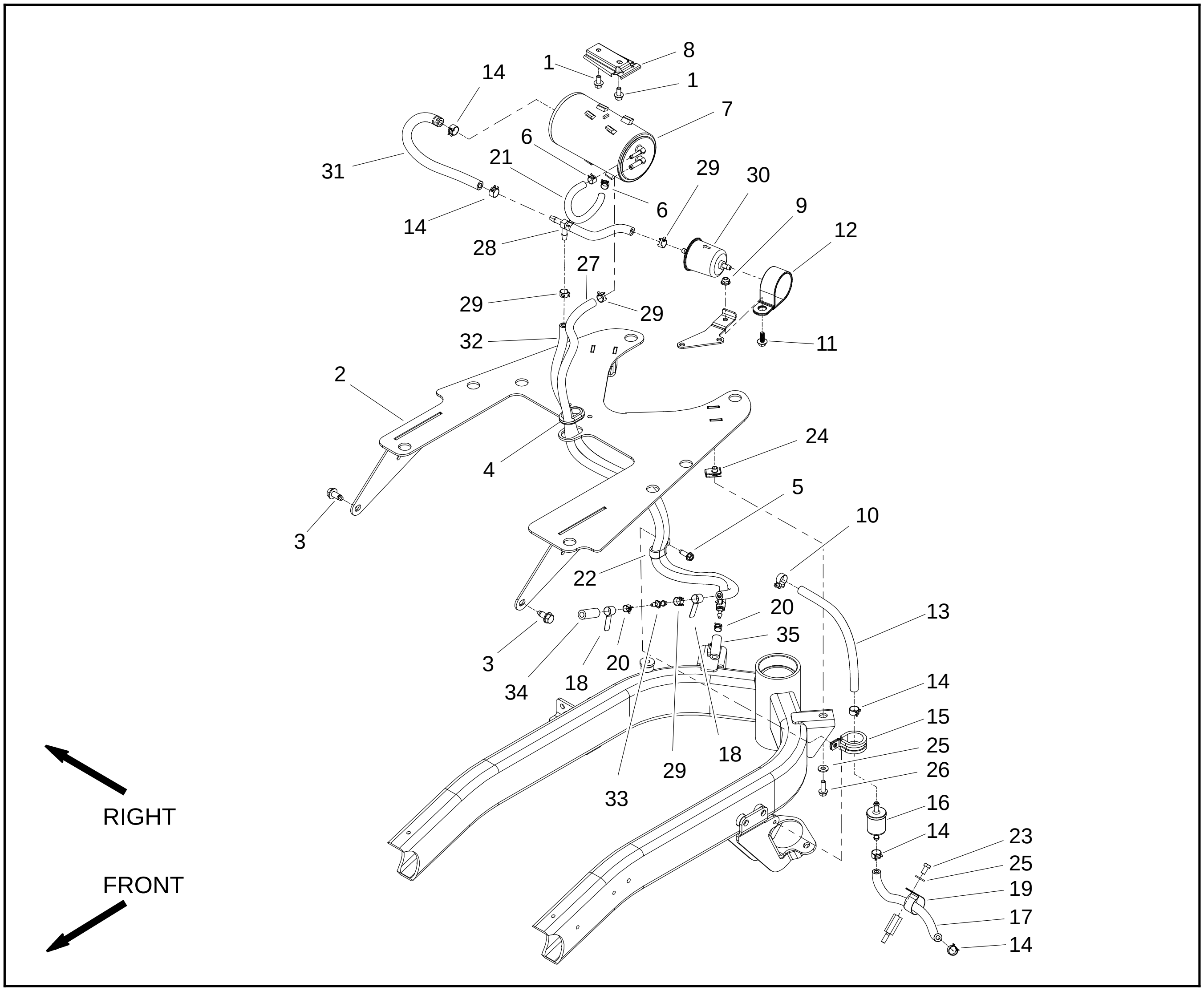

Figure 5

1. Flange head screw (2 used)
2. Tank mount plate
3. Washer head screw (2 used)
4. Grommet (2 used)
5. Washer head screw
6. Hose clamp (2 used)
7. Carbon cannister
8. Cannister bracket
9. Nut
10. Worm clamp
11. Cap screw
12. R-clamp
13. Fuel hose (fuel supply)
14. Hose clamp (5 used)
15. R-clamp
16. Fuel filter (fuel supply)
17. Fuel hose (fuel supply)
18. Label (air cleaner)
19. R-clamp
20. Hose clamp (2 used)
21. Fuel hose (to vent valve on fuel tank)
22. R-clamp
23. Cap screw
24. Clip (2 used)
25. Flat washer (3 used)
26. Flange head screw (2 used)
27. Purge hose assembly (see NOTE)
28. Tee hose assembly (see NOTE)
29. Hose clamp (4 used)
30. Fresh air filter
31. Fuel hose
32. Fuel hose
33. Barbed fitting
34. Engine hose (to air cleaner)
35. Engine hose (to intake manifold)

The function of the fuel evaporative control system is to collect and store evaporative emissions from the fuel tank and engine. On machines with serial number above 312000000, a carbon canister mounted above the hydraulic reservoir is used to collect the fuel vapors. Fuel vapors from the engine and fuel tank are vented to the canister when the engine is not running. Vapors from the canister are consumed when the engine is running.

NOTE: The purge hose assembly (item 27) and tee hose assembly (item 28) both include a check valve as a component of the assembly. The check valve is not available as a separate part. If either of these hose assemblies are removed, make sure that they are correctly installed to insure correct operation of the evaporative control system.

Removal (Fig. 5)

1. Park machine on a level surface, disengage and lower cutting units, move functional control lever to neutral (N), engage parking brake, stop the engine and remove the key from the ignition switch. Wait for all machine movement to stop.

DANGER

Gasoline is flammable. Use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running or in an enclosed area. Always fill fuel tank outside and wipe up any spilled fuel before starting the engine. Store fuel in a clean, safety-approved container and keep the cap in place. Use gasoline for the engine only; not for any other purpose.

2. Remove leak detector tank (machines with Turf Guardian™ Leak Detector System) or hydraulic reservoir cover (machines without Turf Guardian™ Leak Detector System) to gain access to carbon cannister (see Service and Repairs section of Chapter 5 – Hydraulic System).

3. Inspect carbon cannister for damage or obvious leaks. A damaged or leaking cannister should be replaced.

4. Remove components as needed using Figure 5 as a guide.

   A. If either purge hose assembly (item 27) or tee hose assembly (item 28) is to be removed, label ends of hose for assembly purposes. Both of these assemblies include a check valve so direction of installation is important for correct operation of the evaporative control system. The check valve is not available as a separate part so hose assembly replacement is necessary if the check valve or hose is faulty. To ensure proper operation of check valves, do not attempt to remove them from the hose assembly.

Installation (Fig. 5)

1. Install all removed components using Figure 5 as a guide.

   A. If either purge hose assembly (item 27) or tee hose assembly (item 28) was removed, make sure that installation is correct.

   B. Make sure that fuel hoses are not kinked after installation. Also, secure all hoses with hose clamps.

2. Install leak detector tank (machines with Turf Guardian™ Leak Detector System) or hydraulic reservoir cover (machines without Turf Guardian™ Leak Detector System) (see Service and Repairs section of Chapter 5 – Hydraulic System).

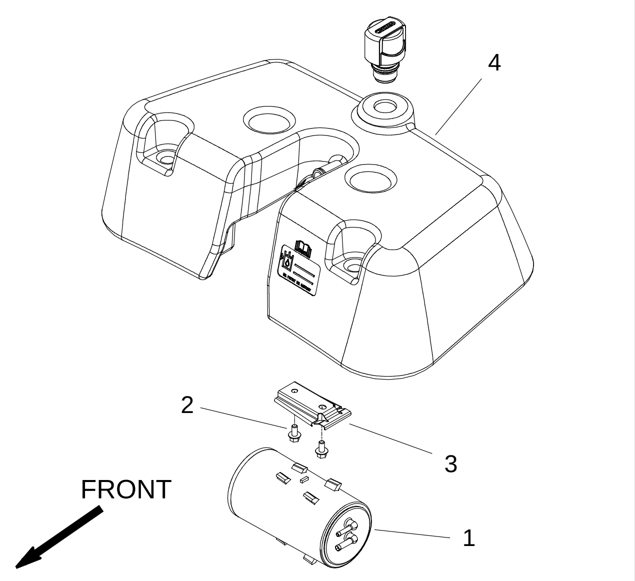

Figure 6

1. **Carbon cannister**
2. **Screw (2 used)**
3. **Cannister bracket**
4. **Leak detector tank**

Fuel Tank

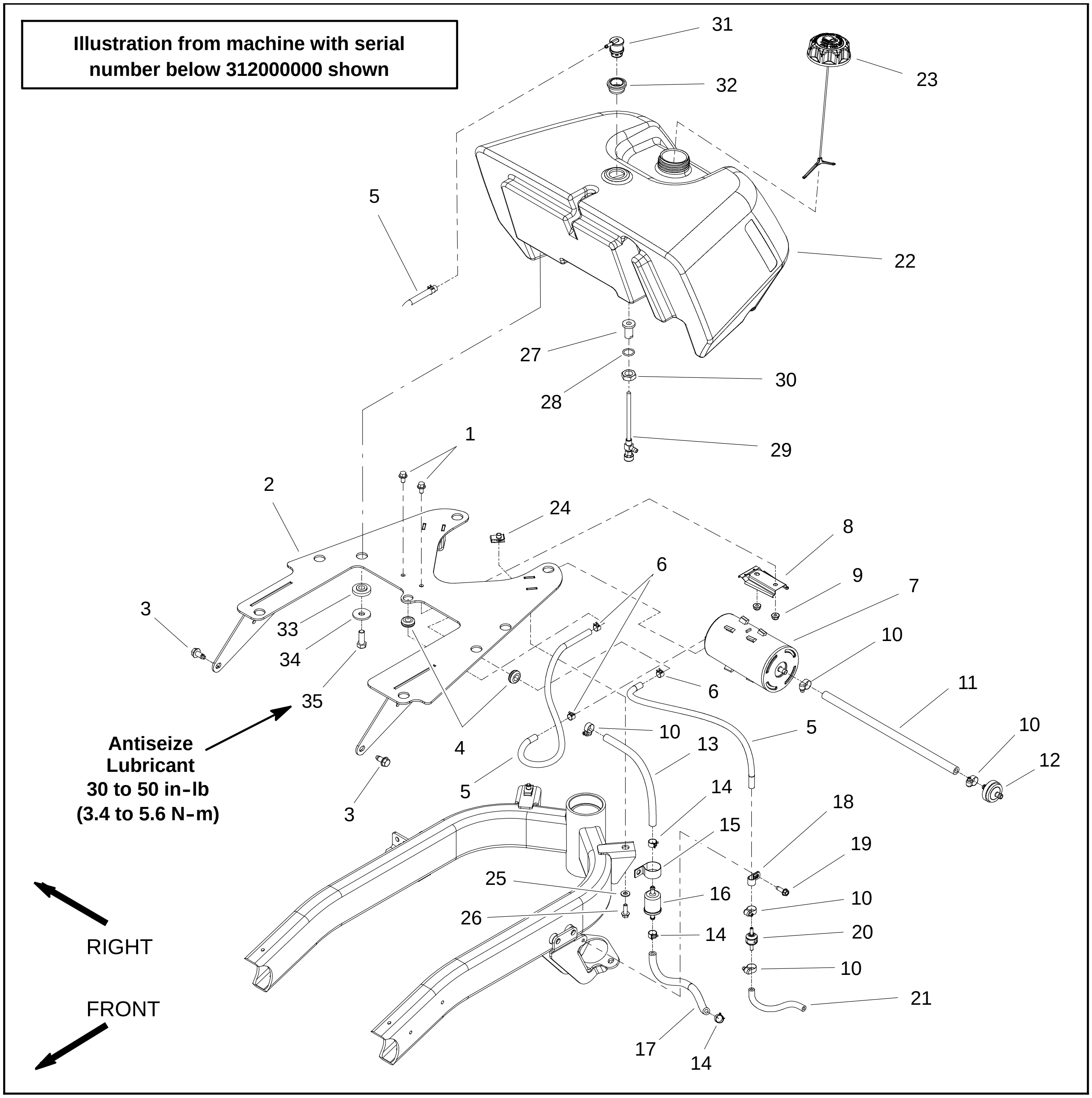
Illustration from machine with serial number below 312000000 shown

Antiseize Lubricant
30 to 50 in-lb
(3.4 to 5.6 N-m)

31
32
23
5
22
27
30
28
1
29
2
24
8
6
9
7
3
33
10
34
11
35
6
10
13
5
10
4
12
5
14
18
3
15
19
25
16
10
26
14
20
RIGHT
10
21
FRONT
17
14

Figure 7

1. **Flange head screw (2 used)**
2. **Tank mount plate**
3. **Washer head screw (2 used)**
4. **Grommet (2 used)**
5. **Fuel hose (2 used)**
6. **Hose clamp (3 used)**
7. **Carbon cannister**
8. **Bracket**
9. **Flange nut (2 used)**
10. **Worm clamp (5 used)**
11. **Fuel hose**
12. **Fresh air filter**
13. **Fuel supply hose**
14. **Hose clamp (3 used)**
15. **R-clamp**
16. **Fuel filter**
17. **Fuel hose**
18. **Clamp**
19. **Washer head screw**
20. **Check valve**
21. **Fuel hose**
22. **Fuel tank**
23. **Fuel tank cap**
24. **Clip (2 used)**
25. **Flat washer (2 used)**
26. **Flange head screw (2 used)**
27. **Fitting (LH thread)**
28. **O-ring**
29. **Shut-off valve**
30. **Nut (LH thread)**
31. **Fuel vent valve**
32. **Grommet**
33. **Flange bushing (4 used)**
34. **Washer (4 used)**
35. **Cap screw (4 used)**

Fuel Tank Removal (Fig. 7)

1. Park machine on a level surface, disengage and lower cutting units, move functional control lever to neutral (N), engage parking brake, stop the engine and remove the key from the ignition switch. Wait for all machine movement to stop.

⚠ **CAUTION**

The muffler and exhaust manifold may be hot. Avoid possible burns, allow exhaust system to cool before working on the engine.

⚠ **DANGER**

Gasoline is flammable. Use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running or in an enclosed area. Always fill fuel tank outside and wipe up any spilled fuel before starting the engine. Store fuel in a clean, safety-approved container and keep the cap in place. Use gasoline for the engine only; not for any other purpose.

2. Drain fuel tank:

   A. Close fuel shut-off valve (item 29).

   B. Disconnect fuel supply hose (item 13) at the fuel filter (item 16) and drain any fuel trapped in the fuel filter and fuel hose into a suitable container.

   C. Place end of fuel hose into a suitable container for draining the tank.

   D. Drain fuel tank by opening the fuel shut off valve.

3. Remove fuel hose (item 5) from fuel vent valve (item 31).

4. Remove four (4) cap screws (item 35), flat washers (item 34) and flange bushings (item 33) that secure the fuel tank to the tank mount plate (item 2). Remove the fuel tank from the machine.

5. If necessary, remove fuel supply hose (item 13) from fuel shut-off valve.

6. If necessary, remove shut-off valve and fitting assembly from fuel tank (Fig. 8). The nut and fitting have left hand threads.

Fuel Tank Installation (Fig. 7)

1. Install fitting assembly and shut-off valve into fuel tank if they were removed from tank (Fig. 8). The nut and fitting have left hand threads.

2. Position fuel tank on the tank mount plate.

3. Secure fuel tank to tank mount plate:

   A. Apply antiseize lubricant to the threads of the four (4) cap screws (item 35).

   B. Secure fuel tank to the tank mount plate with four (4) cap screws (item 35), flat washers (item 34) and flange bushings (item 33).

   C. Torque cap screws from **30 to 50 in-lb (3.4 to 5.6 N-m)**.

4. Install fuel supply hose (item 13) to fuel shut-off valve and fuel filter. Secure supply hose with hose clamps.

5. Connect fuel hose (item 5) to fuel vent valve (item 31) and secure with hose clamp.

6. Fill fuel tank with fuel.

7. Open fuel shut-off valve. Check all fuel hoses and fuel tank for leaks.

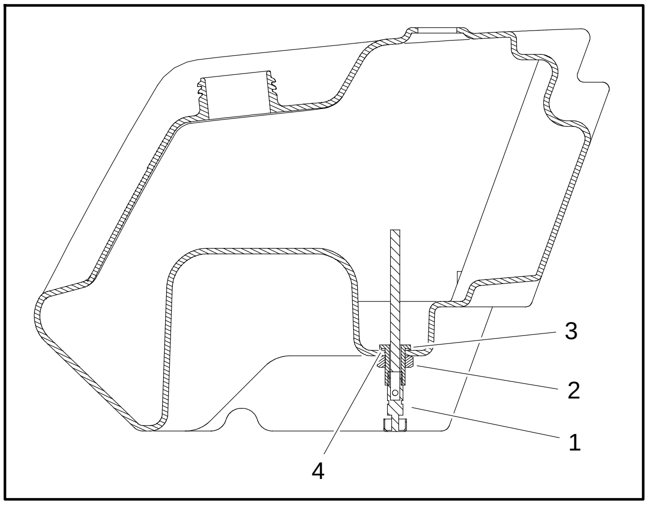

Figure 8

1. **Shut-off valve**
2. **Nut (LH thread)**
3. **Fitting (LH thread)**
4. **O-ring**

Engine

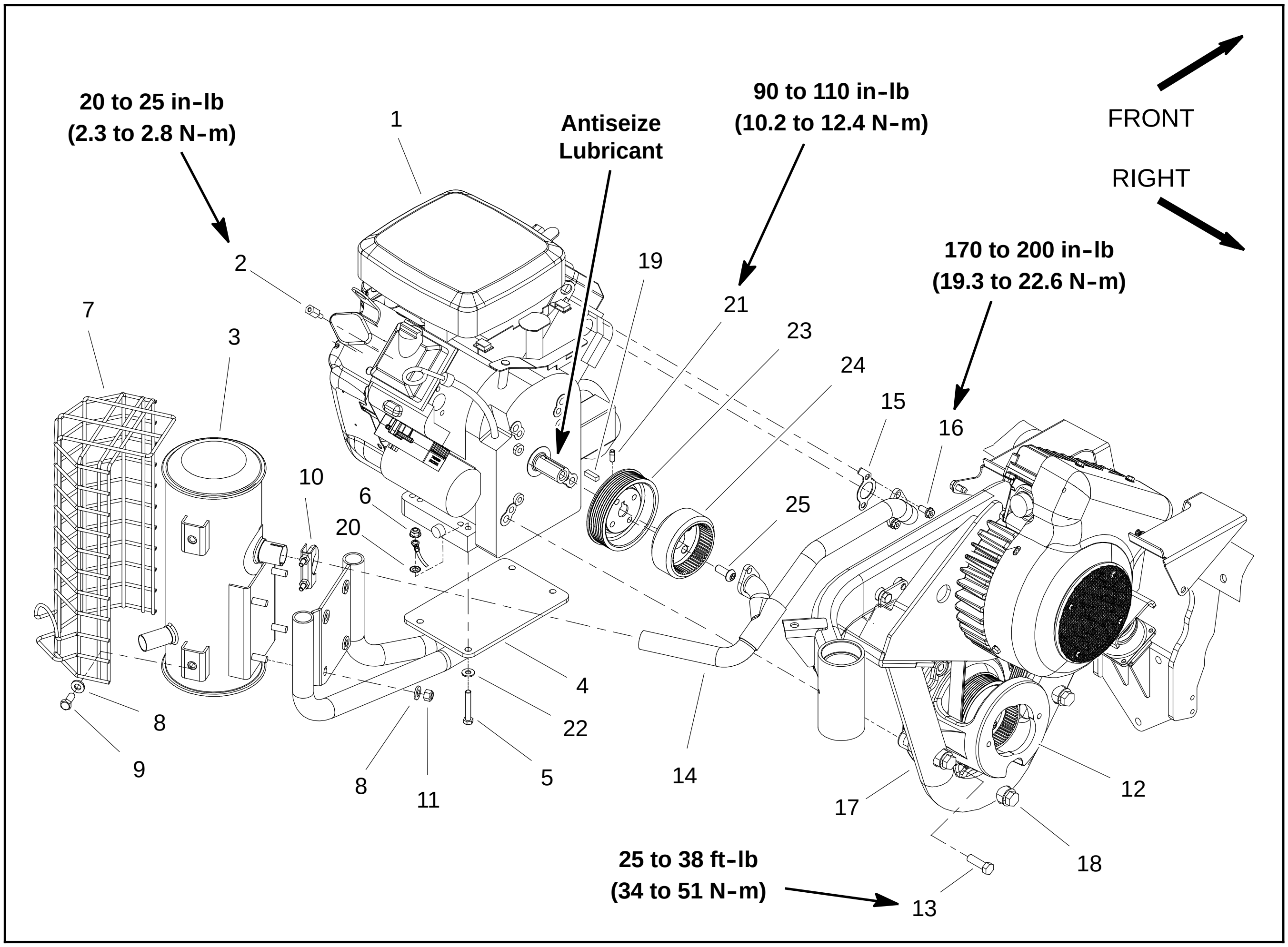
20 to 25 in-lb
(2.3 to 2.8 N-m)
1
Antiseize
Lubricant
90 to 110 in-lb
(10.2 to 12.4 N-m)
FRONT
RIGHT
170 to 200 in-lb
(19.3 to 22.6 N-m)
2
19
21
7
3
23
24
15
16
10
6
20
25
4
22
8
9
8
11
5
14
17
12
18
25 to 38 ft-lb
(34 to 51 N-m)
13

Figure 9

1. Engine assembly	**10. Muffler clamp**	**18. Flange head screw (3 used)**
2. Spacer screw	**11. Lock nut (4 used)**	**19. Square key**
3. Muffler	**12. Pump mount**	**20. Lock washer**
4. Muffler mount	**13. Cap screw (4 used)**	**21. Square head screw (2 used)**
5. Cap screw (4 used)	**14. Exhaust manifold**	**22. Flat washer (4 used)**
6. Flange nut (4 used)	**15. Gasket (2 used)**	**23. Generator pulley**
7. Muffler shield	**16. Flange head screw (4 used)**	**24. Coupling**
8. Hardened washer (8 used)	**17. Engine frame**	**25. Socket head screw (4 used)**
9. Cap screw (4 used)		

Engine Removal (Fig. 9)

1. Park machine on a level surface, disengage and lower cutting units, move functional control lever to neutral (N), engage parking brake, stop the engine and remove the key from the ignition switch. Wait for all machine movement to stop.

CAUTION

The engine and exhaust system may be hot. Avoid possible burns, allow engine and exhaust system to cool before working on the engine.

DANGER

Gasoline is flammable. Use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running or in an enclosed area. Always fill fuel tank outside and wipe up any spilled fuel before starting the engine. Store fuel in a clean, safety-approved container and keep the cap in place. Use gasoline for the engine only; not for any other purpose.

2. Disconnect battery cables from battery. Disconnect negative battery cable first and positive cable last.

3. Close fuel shut-off valve on fuel tank.

4. Disconnect fuel hoses from the fuel filter outlet and the check valve near rear engine cylinder head (Fig. 10). Drain any fuel trapped in the fuel filter and fuel hose into a suitable container.

5. Disconnect choke and throttle control cables from engine.

6. Loosen and remove cap screw (item 5), flat washer (item 22), lock washer (item 20) and flange nut (item 6) that secure wire harness ground connectors to engine assembly (location shown in Fig. 11).

7. Disconnect wire harness connectors from engine components:

NOTE: Before disconnecting wire harness connectors, label all electrical leads for assembly purposes.

A. Alternator wire (from regulator/rectifier) (Fig. 11)

B. Fuel solenoid (Fig. 11)

C. Magneto (Fig. 11)

D. Oil pressure switch (next to oil filter)

E. Starter motor (Fig. 11)

F. Ground wire at rear muffler mount screw

8. Remove tension on generator belt and remove belt from the generator pulley attached to engine crankshaft (see Generator Belt (Greensmaster 3320) in the Service and Repairs section of Chapter 6 – Electrical System).

9. Support the engine assembly to prevent it from shifting or falling.

10. Remove four (4) cap screws (item 13) that secure engine assembly to pump mount (item 12).

IMPORTANT: Make sure to not damage the engine, fuel lines, hydraulic hoses, electrical harness, control cables or other parts while removing the engine.

11. Carefully move the engine assembly away from the pump mount to slide the engine coupling/pulley off the pump coupling (Fig. 12). Once the engine has cleared the coupling, remove the engine from the machine.

12. If necessary, remove the coupling and generator pulley from the engine crankshaft using Figure 9 as a guide.

13. If necessary, remove exhaust system components from engine using Figure 9 as a guide.

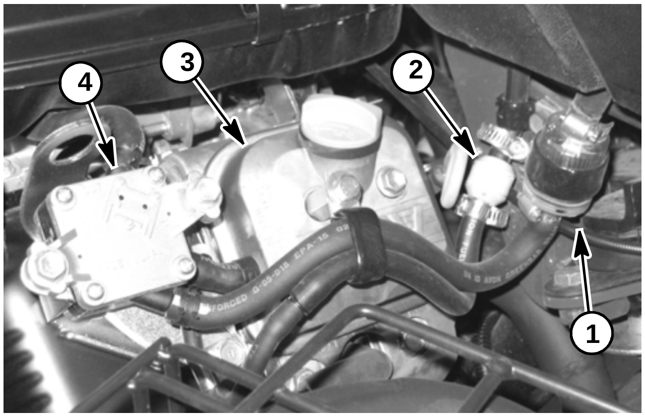

Figure 10

1. **Fuel filter**
2. **Check valve**
3. **Rear cylinder head**
4. **Fuel pump**

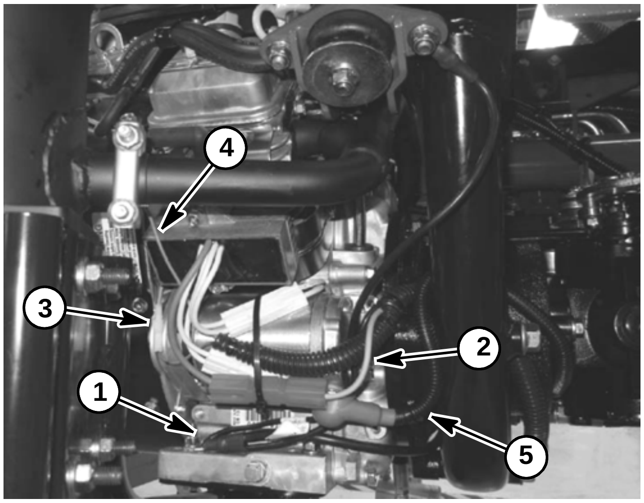

Figure 11

1. **Ground connectors**
2. **Alternator wire**
3. **Fuel solenoid**
4. **Magneto wire**
5. **Starter motor cable**

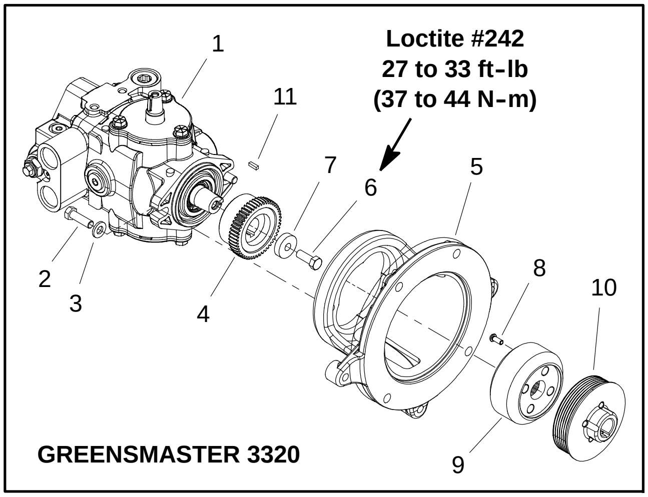

Figure 12

1. **Piston pump**
2. **Cap screw (2 used)**
3. **Flat washer (2 used)**
4. **Coupling**
5. **Pump mount**
6. **Cap screw**
7. **Spacer**
8. **Screw (4 used)**
9. **Coupling**
10. **Generator drive pulley**
11. **Key**

Engine Installation (Fig. 9)

1. Make sure that all removed engine components are correctly installed to the engine.

2. If exhaust system components were removed from engine, attach removed components using Figure 9 as a guide.

3. If the coupling and generator pulley were removed from the engine crankshaft:

   A. Position square key (item 19) to crankshaft. Apply antiseize lubricant to engine crankshaft and key.

   B. Slide pulley and coupling assembly fully onto crankshaft.

   C. Apply Loctite #242 (or equivalent) to two (2) square head screws (item 21). Secure pulley to crankshaft with square head screws. Torque screws from **90 to 110 in–lb (10.2 to 12.4 N–m)**.

IMPORTANT: Make sure to not damage the engine, fuel hose, hydraulic hoses, electrical harness, control cables or other parts while installing the engine.

4. Position and support engine so that the coupling/generator pulley assembly is aligned with the pump coupling (Fig. 12).

5. While supporting the engine to maintain alignment, carefully move the engine toward the pump mount to slide the engine coupling/pulley onto the pump coupling. Route generator belt to pulley as engine is being moved into place. Once the engine contacts the pump mount, align mounting holes and secure engine to pump mount with four (4) cap screws (item 13). Torque cap screws from **25 to 38 ft–lb (34 to 51 N–m)**.

6. Position generator belt to the generator pulley attached to engine crankshaft and tension the belt (see Generator Belt (Greensmaster 3320) in the Service and Repairs section of Chapter 6 – Electrical System).

7. Secure wire harness ground connector to engine assembly with cap screw (item 5), flat washer (item 22), lock washer (item 20) and flange nut (item 6) (location shown in Fig. 11). Make sure that lock washer is positioned between ground connector and engine flange to ensure ground connection to engine.

8. Connect all wire harness connectors to correct engine components.

9. Connect and adjust the choke control cable (see Adjusting the Choke Control in the Adjustments section of this chapter).

10. Connect and adjust the throttle control cable (see Adjusting the Throttle Control in the Adjustments section of this chapter).

11. Connect fuel hoses to the fuel filter outlet and check valve near rear engine cylinder head (Fig. 10). Secure hoses with hose clamps.

12. Connect battery cables to battery. Connect positive battery cable first and negative cable last.

13. Open fuel tank shut–off valve and check fuel hose for leaks.

14. Check engine oil level and adjust if necessary.

15. Start the engine and check for proper operation.

Chapter 4

Diesel Engine

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KUBOTA WORKSHOP MANUAL, DIESEL ENGINE,
  SM-E3B SERIES

Specifications

Item	**Description**
Make / Designation	Kubota water-cooled, Diesel, Model D902-E3B
Number of Cylinders	3
Bore x Stroke	2.83” x 2.9” (72mm x 73.6mm)
Total Displacement	54.8 in^3 (898 cc)
Compression Ratio	24.0:1
Firing Order	1 (closest to gear case end) – 2 – 3 (closest to flywheel end)
Direction of Rotation	Counterclockwise (viewed from flywheel)
Fuel	Diesel or Biodiesel (up to B20) Fuel with Low or Ultra Low Sulfur Content
Fuel Injector Pump	Bosch MD Type Mini
Fuel Injection Nozzle	Bosch Throttle Type
Fuel Capacity	6.0 U.S. gallons (22.7 liters)
Governor	Centrifugal Mechanical
Low Idle (no load)	1500 +150/–100 RPM
High Idle (no load)	2880 ± 50 RPM
Engine Oil	API CH-4, CI-4 or higher
Engine Oil Viscosity	See Operator’s Manual
Oil Pump	Gear Driven Trochoid Type
Crankcase Oil Capacity	3.9 U.S. quarts (3.7 liters) with filter
Cooling System Capacity (including reserve tank)	4.9 U.S. quarts (4.6 liters)
Starter	12 VDC 1.2 KW
Alternator/Regulator	12 VDC 60 AMP
Dry Weight (approximate)	159 lbs (72 kg)

General Information

Information about specifications, maintenance, troubleshooting, testing and repair of the gasoline engine used in the Greensmaster TriFlex Hybrid 3420 is included in this chapter and the Kubota Workshop Manual, Diesel Engine, SM-E3B Series.

Most engine repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kubota Workshop Manual. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Kubota engines are supplied through your local local Toro distributor. If no parts list is available, be sure to provide your distributor with the Toro model and serial number.

Operator’s Manual

The Traction Unit Operator’s Manual provides information regarding the operation, general maintenance and maintenance intervals for your Greensmaster machine. Refer to the Operator’s Manual for additional information when servicing the machine.

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Adjustments

Adjust Throttle Control

Proper throttle operation is dependent upon proper adjustment of throttle control. Make sure throttle control is operating properly.

NOTE: The throttle cable swivel should be positioned in the lowest hole in the speed control lever.

1. Move throttle control lever on control console to **FAST** position.

2. Check position of the engine speed control lever on fuel injection pump (Fig. 1). The speed control lever should be contacting the high speed screw when the throttle control lever is in the **FAST** position.

3. If necessary, throttle control can be adjusted by loosening cable jam nuts and repositioning control cable until speed control lever contacts high speed screw when the throttle control lever is in the **FAST** position (Fig. 2). Tighten cable jam nuts after adjustment has been completed.

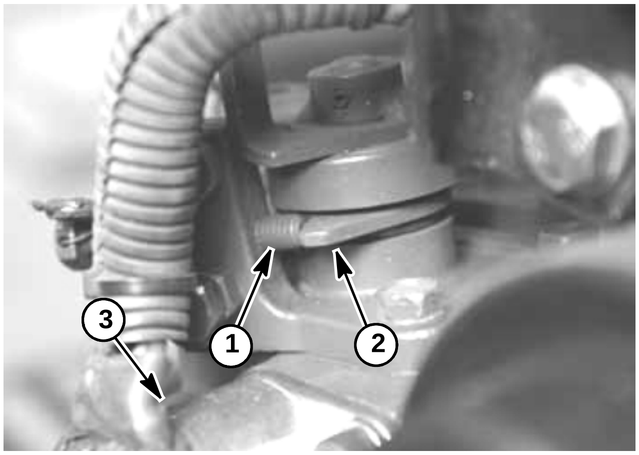

Figure 1

1. **High speed screw**
2. **Speed control lever**
3. **Fuel solenoid**

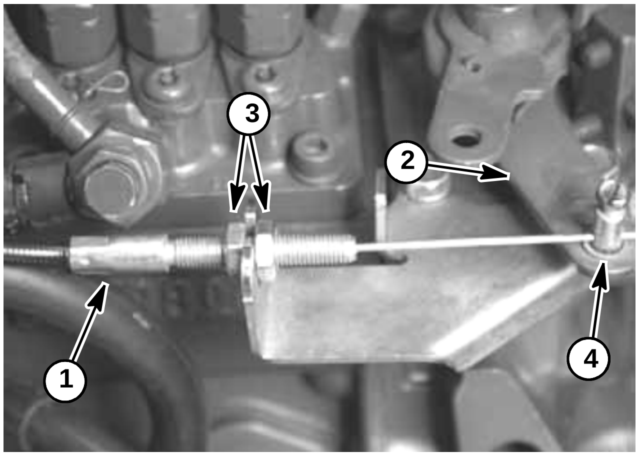

Figure 2

1. **Throttle cable**
2. **Speed control lever**
3. **Cable jam nut**
4. **Throttle cable swivel**

Air Cleaner Assembly

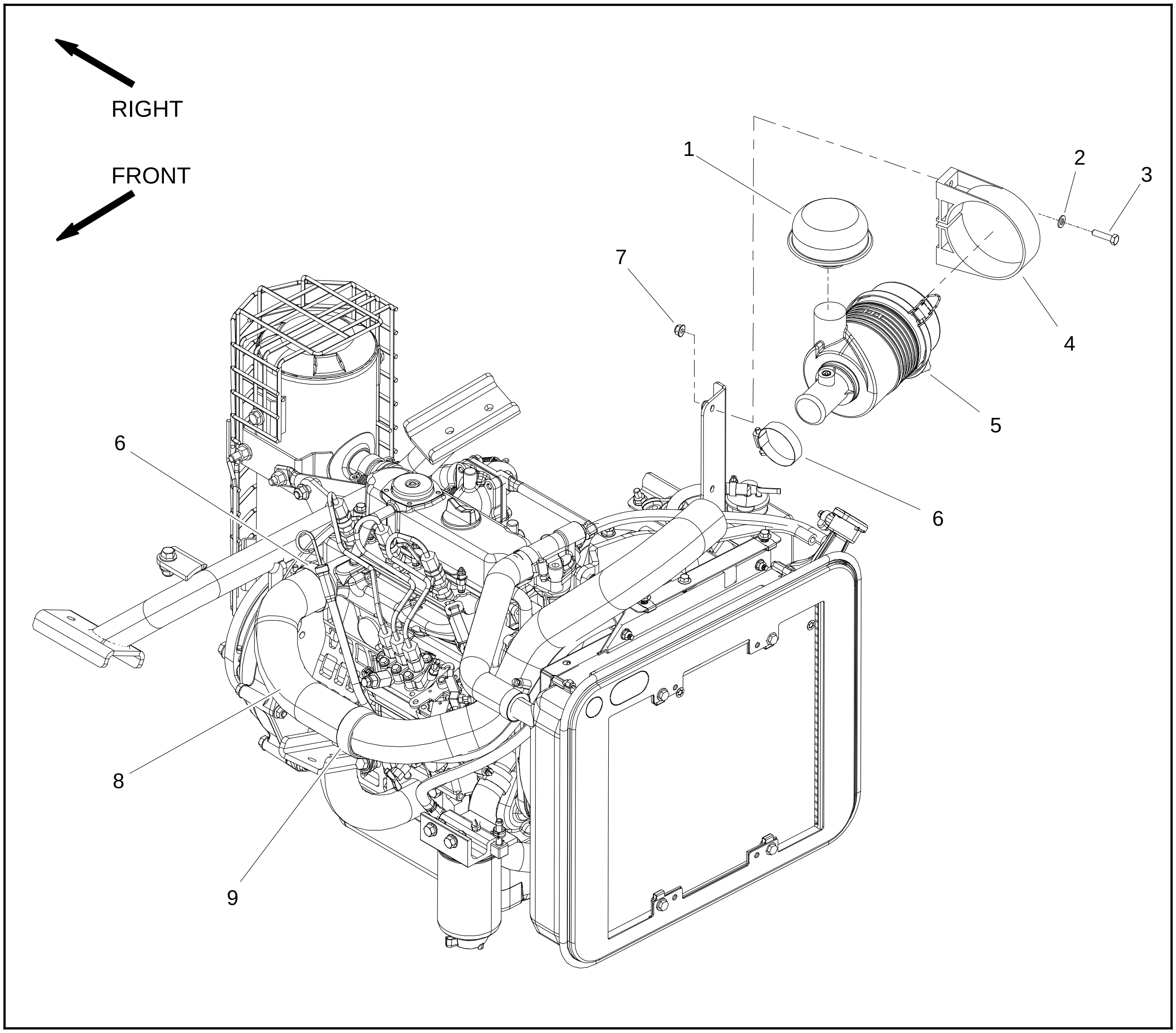

Figure 3

1. **Air inlet hood**	4. **Mounting bracket**	7. **Flange nut (2 used)**
2. **Flat washer (2 used)**	5. **Air cleaner assembly**	8. **Air intake hose**
3. **Cap screw (2 used)**	6. **Hose clamp (2 used)**	9. **R-clamp**

Air Cleaner Removal (Fig. 3)

1. Park machine on a level surface, lower the cutting units, stop the engine, engage parking brake and remove the key from the ignition switch.

2. Remove air cleaner components as needed using Figure 3 as a guide.

3. Check air intake hose (item 8) for damage or wear. Replace hose if damage is found.

4. Disassemble air cleaner as necessary (Fig. 4).

5. Check air cleaner housing and cover for damage that could cause possible air leaks.

Air Cleaner Installation (Fig. 3)

IMPORTANT: Any leaks in the air filter system will allow dirt into engine and will cause serious engine damage. Make sure that all air cleaner components are in good condition and are properly secured during assembly.

1. Assemble air cleaner system using Figures 3 and 4 as guides.

   A. If plug was removed from air cleaner housing, apply sealant to threads of plug before assembly.

   B. Make sure that vacuator valve on air cleaner assembly is pointed down after assembly.

   C. Make sure that air intake hose (item 8) has clearance around it at all points after air cleaner installation is completed.

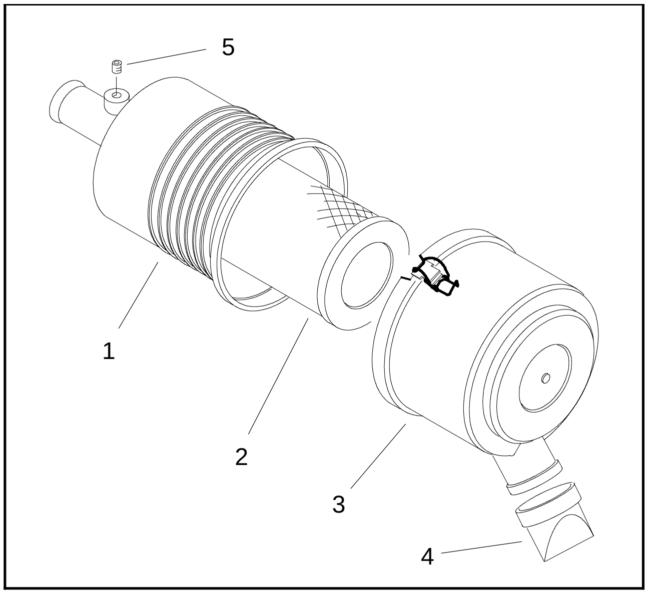

Figure 4

1. Housing
2. Filter element
3. Cover
4. Vacuator valve
5. Plug

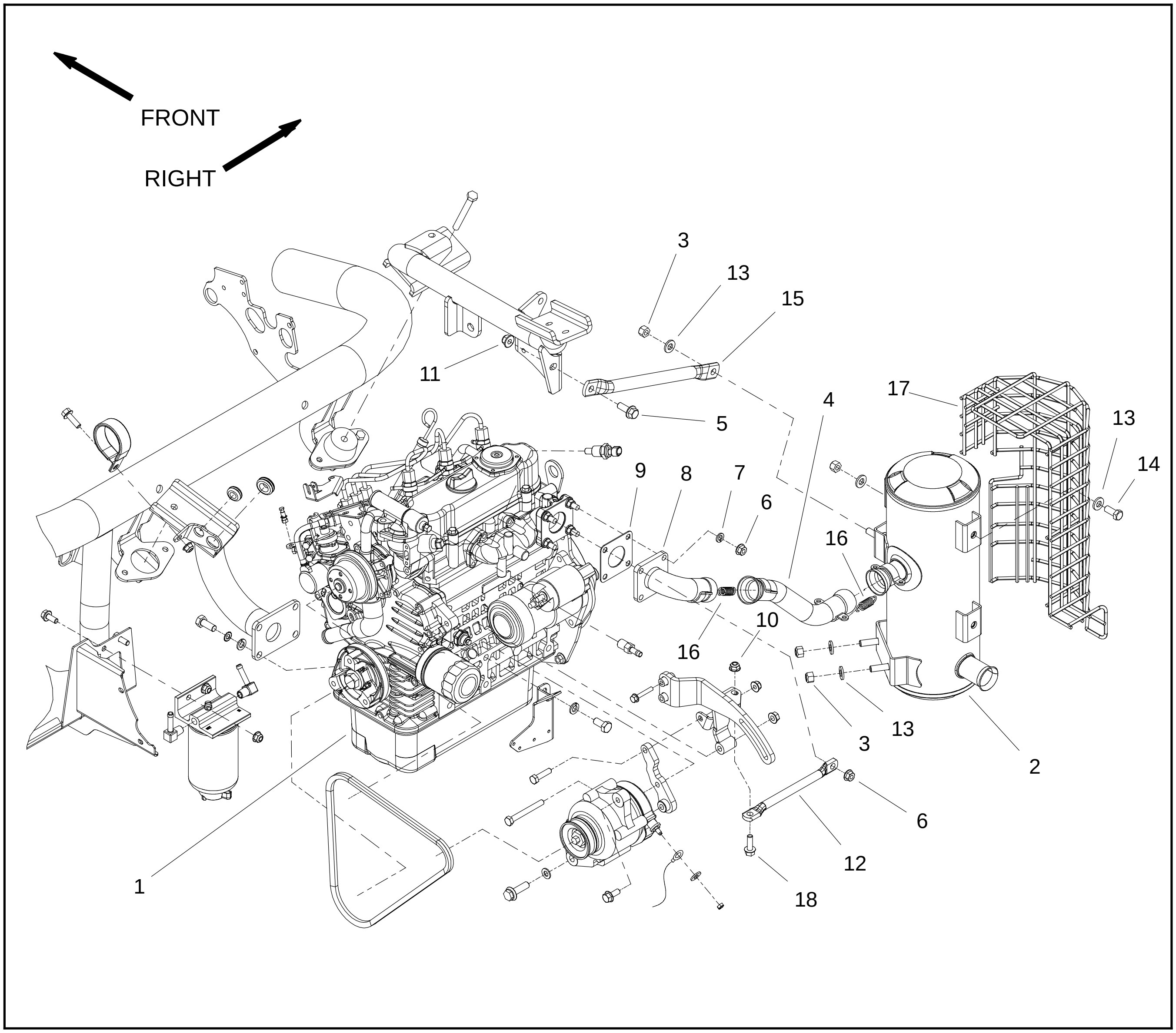
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Figure 5

1. **Engine assembly**
2. **Muffler assembly**
3. **Lock nut (4 used)**
4. **Exhaust pipe**
5. **Flange head screw**
6. **Flange nut (4 used)**
7. **Lock washer (3 used)**
8. **Exhaust plate**
9. **Exhaust gasket**
10. **Flange nut**
11. **Flange nut**
12. **Brace**
13. **Flat washer (8 used)**
14. **Cap screw (4 used)**
15. **Brace**
16. **Spring (4 used)**
17. **Muffler shield**
18. **Flange head screw**

Exhaust System Removal (Fig. 5)

1. Park machine on a level surface, lower the cutting units, stop the engine, engage parking brake and remove the key from the ignition switch.

CAUTION

The muffler and exhaust pipe may be hot. To avoid possible burns, allow the engine and exhaust system to cool before working on the muffler.

2. Remove exhaust system components as needed using Figure 5 as a guide.

NOTE: Muffler assembly is secured to brackets on piston (traction) pump with lock nuts (item 3) and flat washers (item 13).

Exhaust System Installation (Fig. 5)

1. Make sure the engine is off.

IMPORTANT: If exhaust studs were removed from engine cylinder head, thoroughly clean threads in head and apply Loctite #277 (or equivalent) to stud threads before installing studs into head.

NOTE: Make sure exhaust plate and engine exhaust manifold sealing surfaces are free of debris or damage that may prevent a tight seal.

2. If exhaust gasket (item 9) was removed, place new exhaust gasket on the engine exhaust manifold.

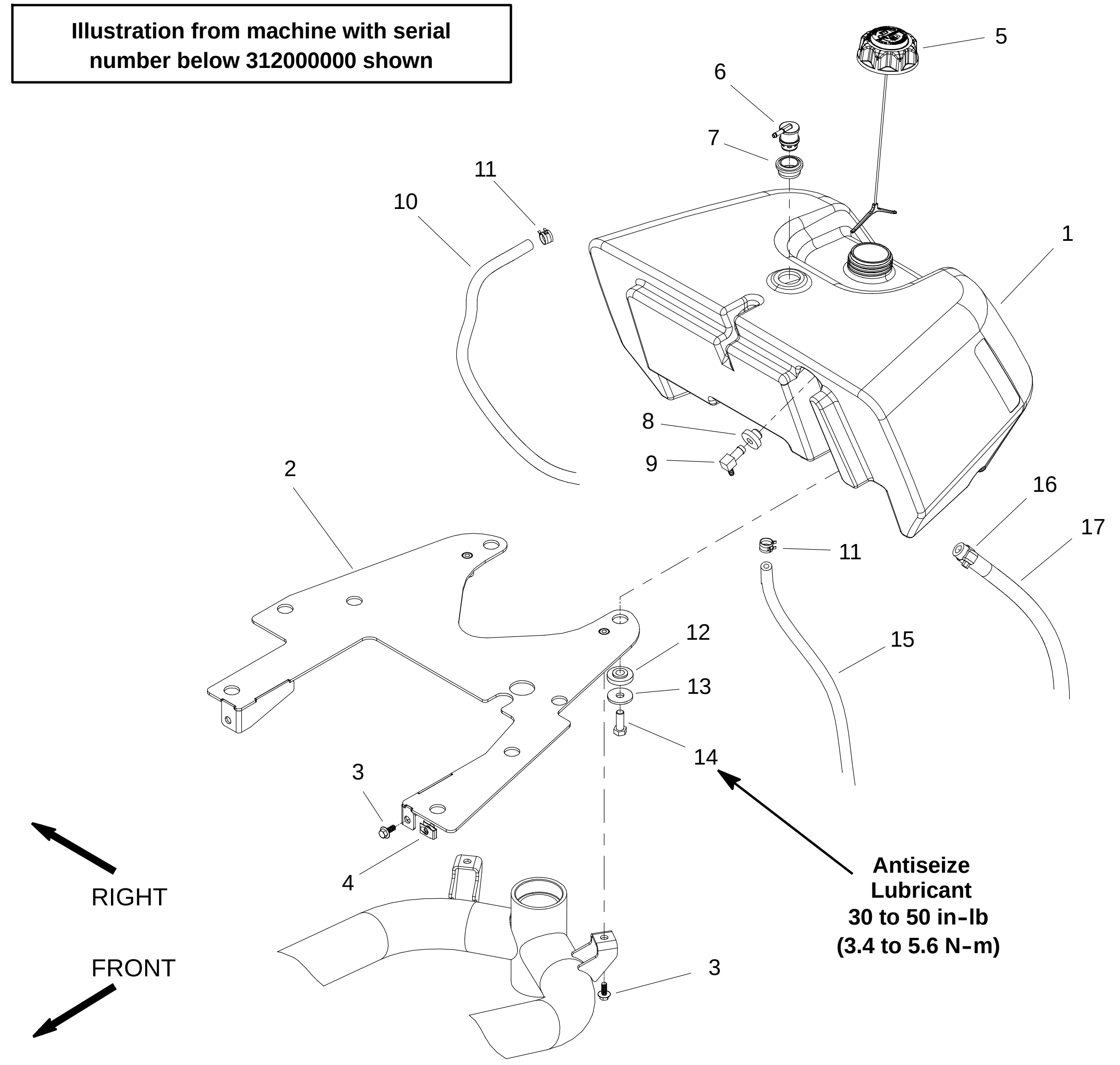
NOTE: To ensure proper exhaust system sealing, mount all exhaust system components loosely before fully tightening any fastener.

3. Assemble all removed exhaust system components using Figure 5 as a guide.

4. After all exhaust components have been assembled, make sure that all fasteners are properly tightened.

Fuel Tank

Illustration from machine with serial number below 312000000 shown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Antiseize Lubricant 30 to 50 in-lb (3.4 to 5.6 N-m)
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Figure 6

1. Fuel tank
2. Tank mount plate
3. Flange head screw (4 used)
4. Clip (2 used)
5. Fuel cap
6. Fuel vent valve
7. Grommet
8. Bushing
9. Elbow fitting
10. Vent hose
11. Hose clamp
12. Flange bushing (4 used)
13. Flat washer (4 used)
14. Cap screw (4 used)
15. Return hose
16. Hose clamp
17. Fuel supply hose

CAUTION

The muffler and exhaust manifold may be hot. Avoid possible burns, allow exhaust system to cool before working on the engine.

Fuel Tank Removal (Fig. 6)

1. Park machine on a level surface, disengage and lower cutting units, move functional control lever to neutral (N), engage parking brake, stop the engine and remove the key from the ignition switch. Wait for all machine movement to stop.

DANGER

Diesel fuel is flammable. Use caution when storing or handling it. Do not smoke while servicing the fuel tank. Do not fill fuel tank while engine is running or in an enclosed area. Always fill fuel tank outside and wipe up any spilled fuel before starting the engine. Store fuel in a clean, safety-approved container and keep the cap in place.

2. Drain fuel tank:

   A. Close fuel shut-off valve on bottom of fuel tank.

   B. Disconnect fuel supply hose at the fuel filter and drain any fuel trapped in the fuel filter and fuel hose into a suitable container.

   C. Place end of fuel hose into a suitable container for draining the tank.

   D. Drain fuel tank by opening the fuel shut off valve.

3. Remove vent hose (item 10) from fuel vent valve (item 6).

4. To allow easier access to fasteners that secure fuel tank, raise and support tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 - Chassis).

5. Remove four (4) cap screws (item 14), flat washers (item 13) and flange bushings (item 12) that secure the fuel tank to the tank mount plate (item 2).

6. Move fuel tank towards the rear of the machine to gain access to fuel return hose (item 15). Remove return hose from elbow fitting on front of tank.

7. Remove the fuel tank from the machine.

8. If necessary, remove fuel supply hose from shut-off valve.

9. If necessary, remove shut-off valve and fitting assembly from fuel tank (Fig. 7). The nut and fitting have left hand threads.

Fuel Tank Installation (Fig. 6)

1. Install fitting assembly and shut-off valve into fuel tank if they were removed from tank (Fig. 7). The nut and fitting have left hand threads.

2. Position fuel tank on the tank mount plate.

3. Move fuel tank towards the rear of the machine and install return hose (item 15) to elbow fitting on front of tank. Secure hose with hose clamp.

4. Secure fuel tank to tank mount plate:

   A. Apply antiseize lubricant to the threads of the four (4) cap screws (item 14).

   B. Secure fuel tank to the tank mount plate with four (4) cap screws (item 14), flat washers (item 13) and flange bushings (item 12).

   C. Torque cap screws from **30 to 50 in-lb (3.4 to 5.6 N-m)**.

5. Lower and secure tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 - Chassis).

6. Connect fuel supply hose (item 17) to the fuel shut-off valve and fuel filter. Secure supply hose with hose clamps.

7. Connect vent hose (item 10) to fuel vent valve (item 6) and secure with hose clamp.

8. Fill fuel tank with fuel.

9. Open fuel shut-off valve. Check all fuel hoses and fuel tank for leaks.

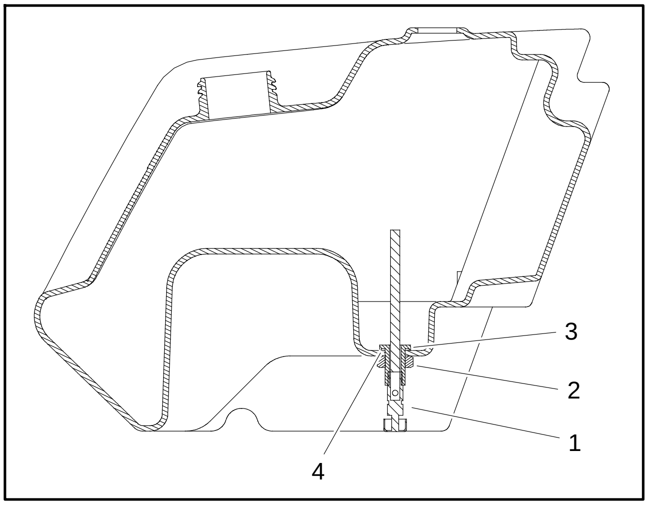

Figure 7

1. **Shut-off valve**
2. **Nut (LH thread)**
3. **Fitting (LH thread)**
4. **O-ring**

Radiator

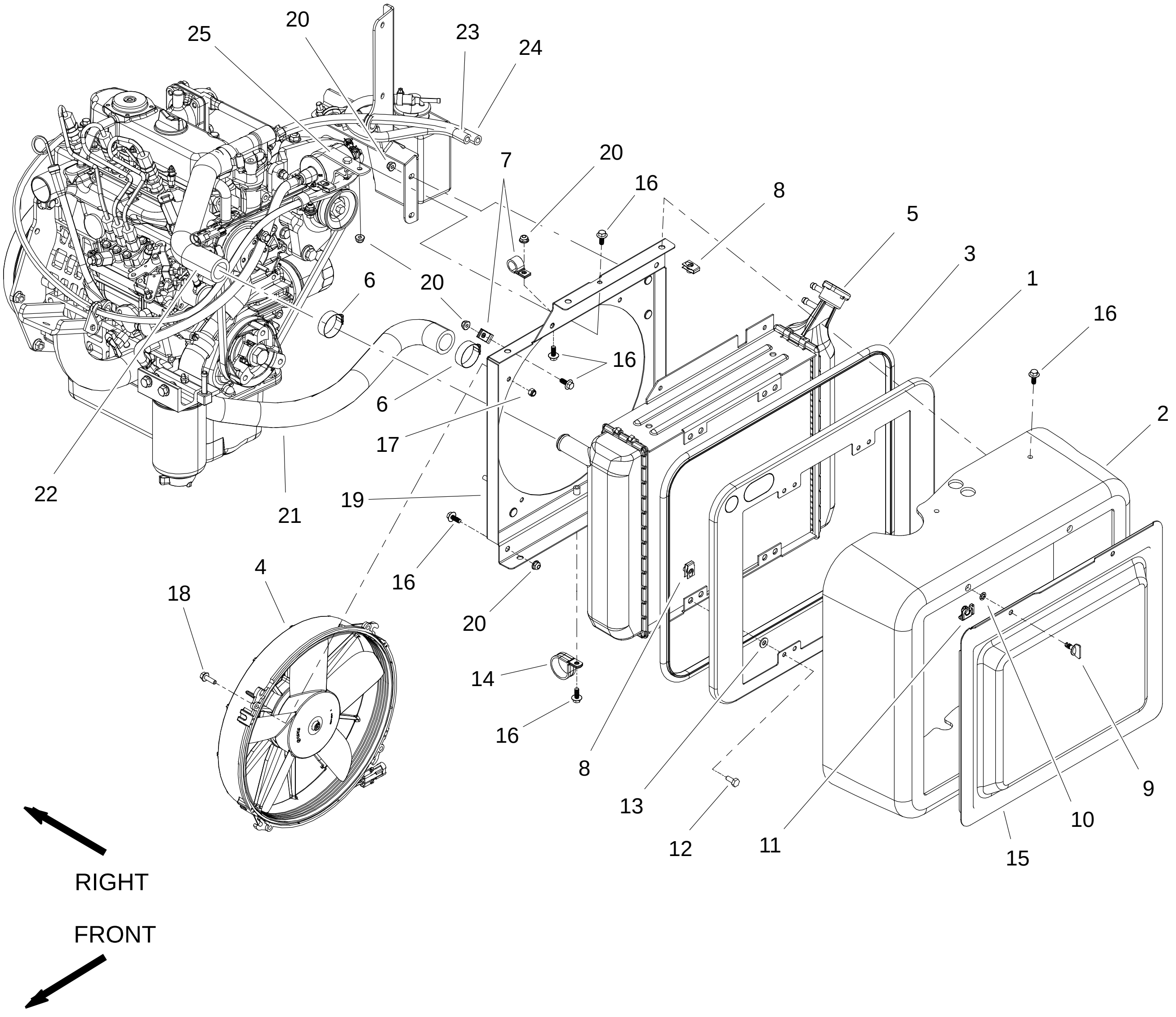

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Figure 8

1. **Seal panel**
2. **Radiator shroud**
3. **Trim seal**
4. **Fan assembly**
5. **Radiator assembly**
6. **Hose clamp (2 used)**
7. **R-clamp (2 used)**
8. **Clip (8 used)**
9. **Stud (2 used)**
10. **Stud retainer (2 used)**
11. **Receptacle (2 used)**
12. **Cap screw (4 used)**
13. **Flat washer (4 used)**
14. **R-clamp**
15. **Screen**
16. **Flange head screw (12 used)**
17. **Lock nut (4 used)**
18. **Flange head screw (4 used)**
19. **Front shroud**
20. **Flange nut (12 used)**
21. **Lower radiator hose**
22. **Upper radiator hose**
23. **Breather hose (to thermostat)**
24. **Overflow hose (to overflow tank)**
25. **Fuel pump**

Radiator Removal (Fig. 8)

1. Park machine on a level surface, lower the cutting units, stop the engine, engage parking brake and remove the key from the ignition switch.

CAUTION

DO NOT open radiator cap or drain coolant if the engine or radiator is hot. Pressurized hot coolant can escape and cause burns.

Ethylene-gycol antifreeze is poisonous. Dispose of it properly or store it in a properly labeled container away from children and pets.

2. Remove the radiator cap.

3. Drain radiator into a suitable container by disconnecting lower radiator hose (item 21) from the radiator.

4. Remove screen (item 15) from radiator shroud.

5. Remove four (4) flange head screws (item 16) that secure radiator shroud (item 2) to radiator assembly. Remove radiator shroud.

6. Remove flange head screw that secures R-clamp (item 14) to bottom of front shroud (item 19).

7. Remove the following hoses from the radiator:

    A. Loosen hose clamps and disconnect breather hose (item 24) and overflow hose (item 23) from radiator filler neck.

    B. Loosen hose clamp (item 6) and disconnect upper radiator hose (item 22).

8. Locate splice fitting in fuel return hose near fuel pump. Disconnect one of the return hose sections from splice fitting and remove return hose from both r-clamps (item 7) on front shroud (item 19).

9. Remove flange head screw and flange nut that secure fuel pump assembly to front shroud. Position fuel pump assembly away from radiator assembly.

10. Disconnect fan wire connector from machine wire harness.

11. Support radiator assembly to prevent it from falling.

12. Remove four (4) flange nuts that secure front shroud to machine. Remove radiator assembly from machine.

13. Remove components from radiator as necessary using Figure 8 as a guide.

Radiator Installation (Fig. 8)

1. Assemble all removed components to radiator using Figure 8 as a guide.

2. Position radiator assembly to machine. Secure front shroud to machine with four (4) flange nuts.

3. Position fuel pump assembly to radiator assembly and secure with flange head screw and flange nut.

4. Connect fan wire connector to machine wire harness.

5. Slide return hose through both r-clamps (item 7) on front shroud (item 19). Connect return hose sections at splice fitting and secure with hose clamp.

6. Connect the following hoses to the radiator and secure with hose clamps:

    A. Upper and lower radiator hoses (items 22 and 21).

    B. Breather hose (item 24) and overflow hose (item 23) to radiator filler neck.

7. Secure R-clamp (item 14) to bottom of front shroud (item 19).

8. Secure radiator shroud (item 2) to radiator assembly with four (4) flange head screws (item 16).

9. Install screen (item 15) to radiator shroud.

10. Fill radiator with coolant. Check radiator and hoses for leaks.

Starter Motor

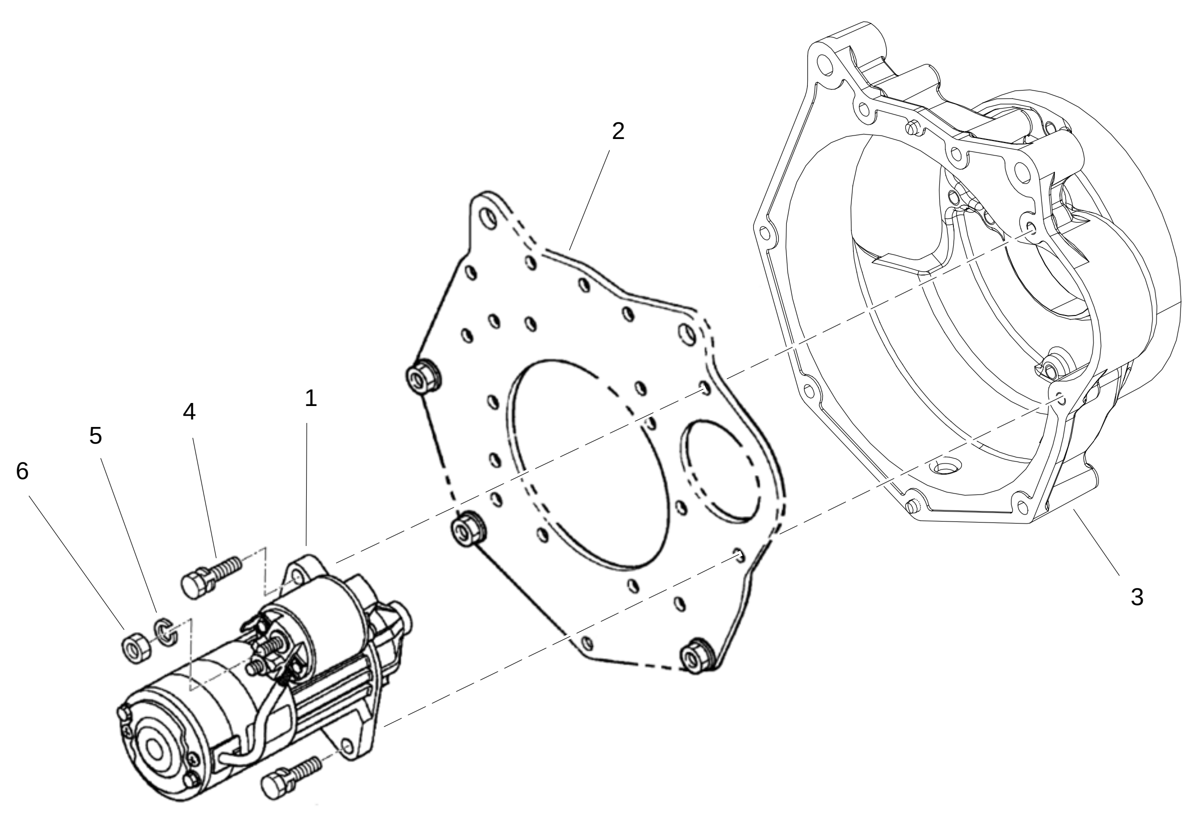

Figure 9

1. Starter motor	**3. Bell housing**	**5. Lock washer (2 used)**
2. Flywheel plate	**4. Cap screw (2 used)**	**6. Nut (2 used)**

Starter Motor Removal (Fig. 9)

1. Park machine on a level surface, disengage and lower cutting units, move functional control lever to neutral (N), engage parking brake, stop the engine and remove the key from the ignition switch. Wait for all machine movement to stop.

CAUTION

The engine, radiator, exhaust system and hydraulic system may be hot. To avoid possible injury, allow machine to cool before working on the engine.

2. Disconnect battery cables from battery before removing the starter motor. Disconnect negative battery cable first and positive cable last.

3. Label all wires at starter solenoid for assembly purposes. Disconnect machine wires from starter solenoid posts.

4. Support starter motor to prevent it from shifting or falling.

5. Remove two (2) cap screws that secure starter motor to engine. Remove starter motor from machine.

NOTE: Refer to the Kubota Workshop Manual, Diesel Engine, SM–E3B Series for information on starter motor service procedures.

Starter Motor Installation (Fig. 9)

1. Insert starter motor drive into flywheel plate and bell housing.

2. Secure starter motor to engine with two (2) cap screws.

3. Using labels placed during starter removal, connect machine wires to starter solenoid posts.

4. Connect battery cables to battery. Connect positive battery cable first and negative cable last.

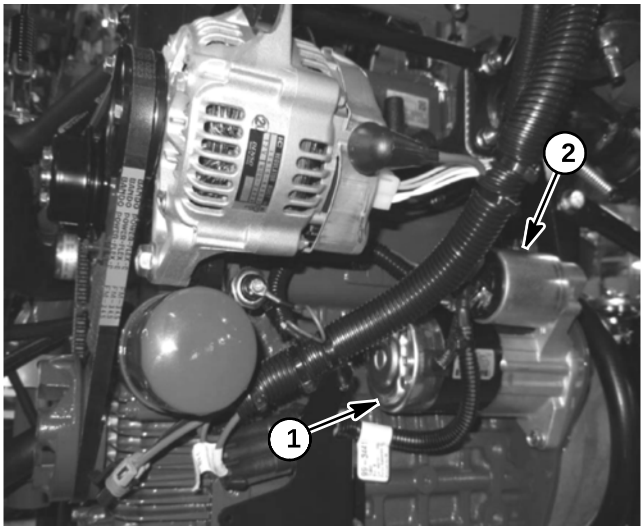

Figure 10

1. **Starter motor**
2. **Starter motor solenoid**

Engine

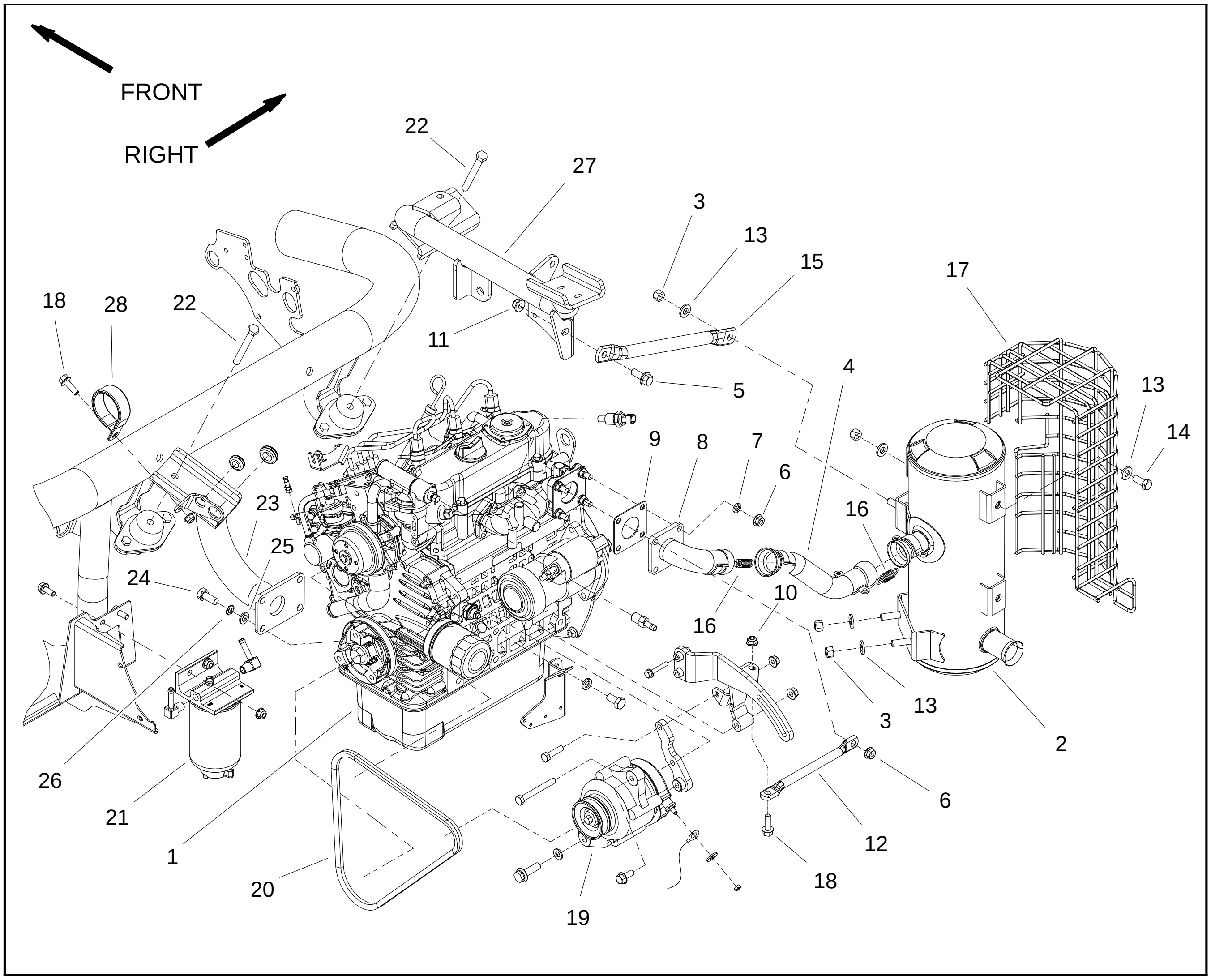

Figure 11

1. Engine assembly	**11. Flange nut**	**20. V-belt**
2. Muffler assembly	**12. Brace**	**21. Fuel/water separator**
3. Lock nut (4 used)	**13. Flat washer (8 used)**	**22. Cap screw (2 used)**
4. Exhaust pipe	**14. Cap screw (4 used)**	**23. Engine support**
5. Flange head screw	**15. Brace**	**24. Cap screw (4 used)**
6. Flange nut (4 used)	**16. Spring (4 used)**	**25. Lock washer (4 used)**
7. Lock washer (3 used)	**17. Muffler shield**	**26. Lock washer (ground connection)**
8. Exhaust plate	**18. Flange head screw**	**27. Rear engine mount**
9. Exhaust gasket	**19. Alternator assembly**	**28. R-clamp (air intake hose)**
10. Flange nut		

NOTE: This suggested engine removal procedure allows the hydraulic pump, bell housing and generator assembly to remain in the machine.

Engine Removal (Fig. 11)

1. Park machine on a level surface, disengage and lower cutting units, move functional control lever to neutral (N), engage parking brake, stop the engine and remove the key from the ignition switch. Wait for all machine movement to stop.

CAUTION

The engine, radiator, exhaust system and hydraulic system may be hot. To avoid possible injury, allow machine to cool before working on the engine.

2. Disconnect battery cables from battery. Disconnect negative battery cable first and positive cable last.

3. Close fuel shut-off valve on fuel tank.

4. Remove air cleaner and air intake hose from machine (see Air Cleaner Removal in this section).

5. Remove radiator from machine (see Radiator Removal in this section).

6. Remove exhaust system from machine (see Exhaust System Removal in this section).

7. Remove starter motor from engine (see Starter Motor Removal in this section).

8. Disconnect fuel supply hose from the injector pump and fuel return hose from the #3 injector. Drain any fuel trapped in the hoses into a suitable container. Remove hoses from grommets in engine support on front of engine. Plug hoses and position them away from engine assembly.

9. Loosen screw that secures the throttle cable to swivel on injector pump speed control lever. Disconnect cable from swivel and cable bracket (Fig. 12). Position cable away from engine.

10. Disconnect wire harness connectors from engine components:

NOTE: Before disconnecting wire harness connectors, label all electrical leads for assembly purposes.

A. Negative battery cable.

B. Wire harness ground.

C. Fuel stop solenoid (Fig. 13).

D. Glow plug bus (Fig. 13).

E. Alternator connector and stud (Fig. 14).

F. Temperature sender (Fig. 13).

G. Oil pressure switch (near oil filter) (Fig. 14).

CAUTION

Support the hydraulic pump, bell housing and generator assembly before removing any supporting fasteners to prevent the assembly from shifting and causing component damage or personal injury.

11. Support hydraulic pump, bell housing and generator assembly to prevent it from moving during engine removal.

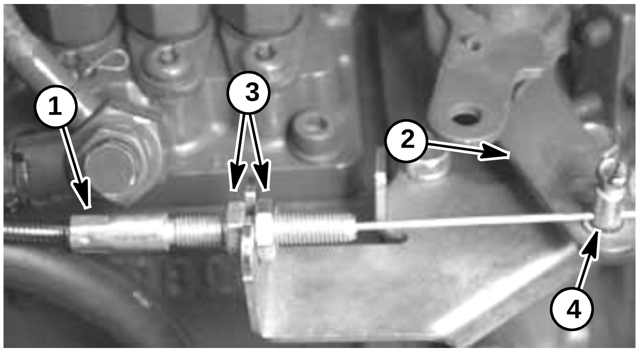

Figure 12

1. Throttle cable
2. Speed control lever
3. Cable jam nut
4. Throttle cable swivel

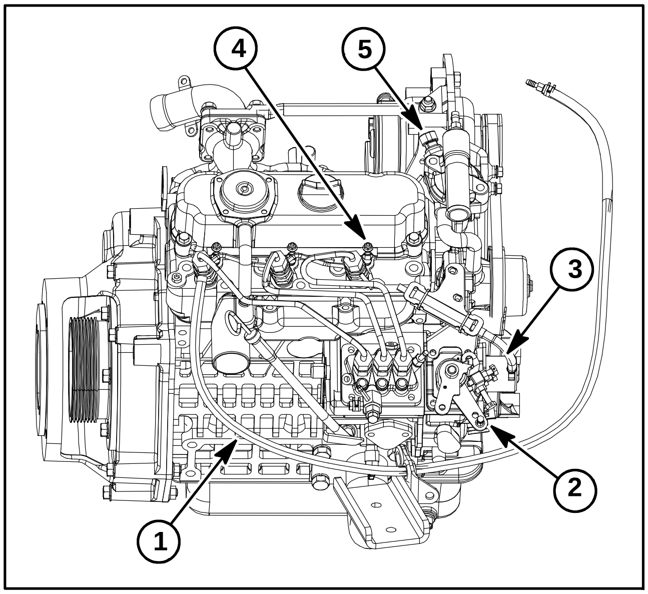

Figure 13

1. Fuel return hose
2. Throttle cable swivel
3. Fuel stop solenoid
4. Glow plug bus
5. Temperature sender

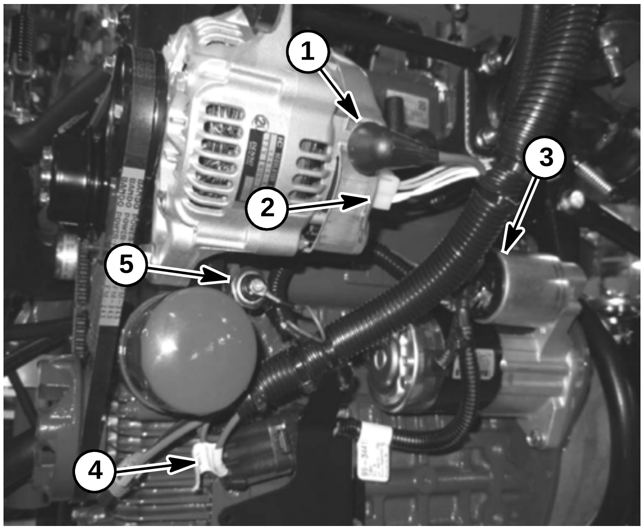

Figure 14

1. Alternator stud
2. Alternator connector
3. Starter motor solenoid
4. Fusible link harness
5. Oil pressure switch

12. Remove tension on generator belt and remove belt from the generator pulley attached to engine (see Generator Drive Belt (Greensmaster 3420) in the Service and Repairs section of Chapter 6 – Electrical System).

CAUTION

When removing engine assembly, make sure lift or hoist can safely support 190 lbs (86 kg).

13. Attach a suitable lift or hoist to engine. Support engine with lift or hoist to prevent engine from shifting or moving.

14. Remove fasteners that secure engine to machine:

A. Remove cap screw, spacer, snubbing washer and flange nut that secure engine support to engine mount (Fig. 15).

B. Remove five (5) flange head screws that secure bell housing to flywheel plate (Fig. 16).

C. Remove two (2) cap screws, washers and lock nuts that secure rear engine plate and bell housing to rear engine mount (Fig. 16).

IMPORTANT: Make sure to not damage the engine, fuel hoses, hydraulic lines, electrical harness or other parts while removing the engine.

15. Slowly move the engine assembly away from the bell housing to allow the pump coupling to slide out of the engine coupling flange (Fig. 17). Once the engine has cleared the pump coupling, carefully remove the engine from the machine.

16. If required, remove engine support (item 23) from engine.

17. If required, remove generator drive pulley and coupling flange from engine flywheel (Fig. 18).

Engine Installation (Fig. 11)

1. Make sure that all removed engine components are correctly installed to the engine.

2. If engine support (item 23) was removed from engine, secure support to engine with removed fasteners.

3. If generator drive pulley and coupling flange were removed from engine, secure pulley and flange to flywheel with removed fasteners (Fig. 18).

4. Make sure that hydraulic pump, bell housing and generator assembly is well supported to prevent it from moving during engine Installation.

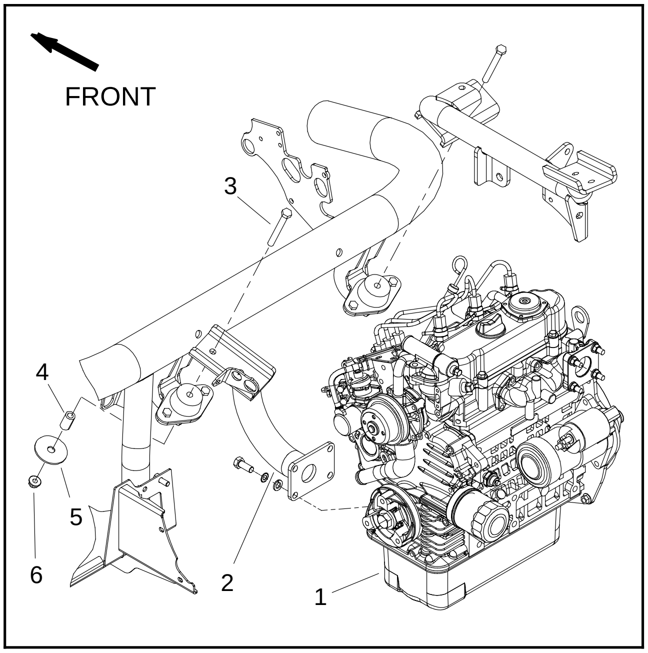

Figure 15

1. Engine
2. Engine mount
3. Cap screw
4. Spacer
5. Rebound washer
6. Flange nut

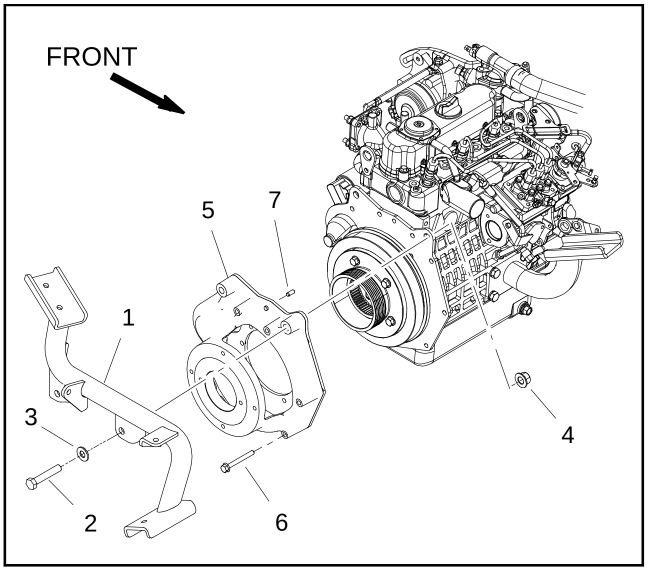

Figure 16

1. Rear engine mount
2. Cap screw (2 used)
3. Washer (2 used)
4. Lock nut (2 used)
5. Bell housing
6. Flange screw (5 used)
7. Dowel pin (2 used)

CAUTION

When installing engine assembly, make sure lift or hoist can safely support 190 lbs (86 kg).

5. Attach a suitable lift or hoist to engine.

IMPORTANT: Make sure to not damage the engine, fuel hoses, hydraulic lines, electrical harness or other parts while installing the engine.

6. Slowly move the engine assembly toward the bell housing to allow the pump coupling to slide into the engine coupling flange (Fig. 17). Route generator belt to pulley as engine is being moved into place.

7. Secure engine to machine:

   A. Secure engine support (item 23) to engine mount with removed fasteners (Fig. 15).

   B. Secure bell housing to flywheel plate with five (5) flange head screws (Fig. 16).

   C. Secure rear engine plate and bell housing to rear engine mount with two (2) cap screws, washers and lock nuts (Fig. 16).

8. Connect throttle cable to the swivel on injector pump speed control lever (Fig. 12). Adjust throttle cable and secure to bracket (see Adjust Throttle Cable in the Adjustments section of this chapter).

9. Install starter motor to engine (see Starter Motor Installation in this section).

10. Install exhaust system to machine (see Exhaust System Installation in this section).

11. Install radiator (see Radiator Installation in this section).

12. Install air cleaner to machine (see Air Cleaner Installation in this section). Make sure that all hose clamps are properly tightened.

13. Connect all electrical harness connectors to engine using labels placed during engine removal.

14. Insert fuel supply hose and fuel return hose through grommets in engine support on front of engine. Remove plugs placed during engine removal from hoses. Connect fuel supply hose to the injector pump fitting and fuel return hose to the #3 injector fitting. Secure fuel hoses with hose clamps.

15. Position generator belt onto pulley and tension belt (see Generator Belt (Greensmaster 3420) in the Service and Repairs section of Chapter 6 – Electrical System).

16. Open fuel shutoff valve on fuel tank. Check tank and hoses for leaks.

17. Fill cooling system with coolant. Check radiator and hoses for leaks.

18. Make sure that alternator belt tension is properly adjusted.

19. Make sure that engine oil level is correct.

20. Connect battery cables to battery. Connect positive battery cable first and negative cable last.

21. Bleed fuel system.

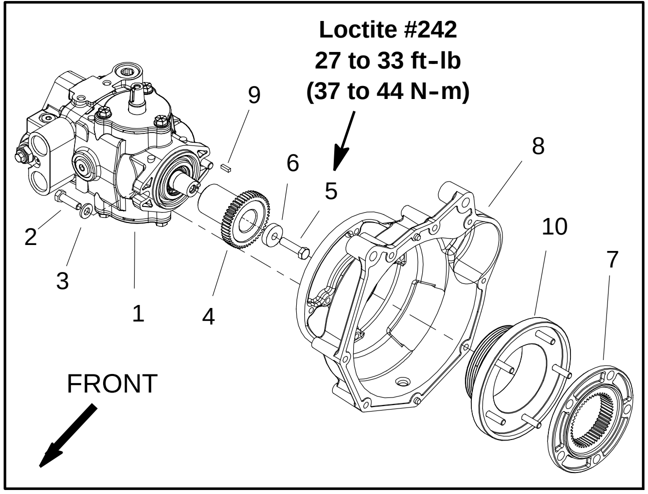

Figure 17

1. **Piston pump**
2. **Cap screw (2 used)**
3. **Flat washer (2 used)**
4. **Coupling**
5. **Cap screw**
6. **Spacer**
7. **Engine coupling flange**
8. **Bell housing**
9. **Key**
10. **Generator drive pulley**

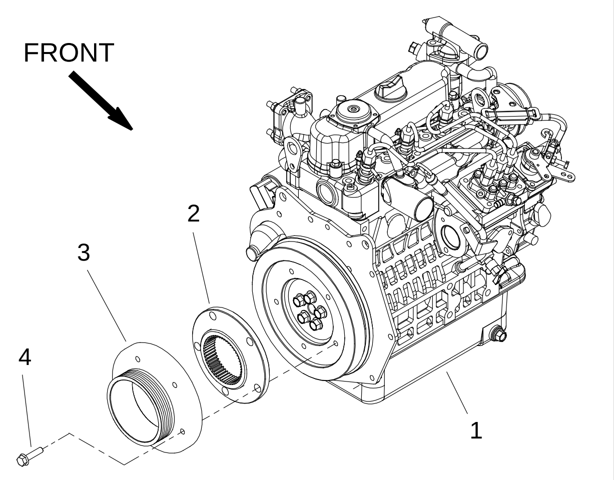

Figure 18

1. **Engine**
2. **Coupling flange**
3. **Generator pulley**
4. **Flange screw (5 used)**

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Chapter 5

Hydraulic System

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EATON, MEDIUM DUTY PISTON PUMP, REPAIR INFORMATION, MODEL 70160 VARIABLE DISPLACEMENT PISTON PUMP
PARKER TORQMOTOR™ SERVICE PROCEDURE (TC, TB, TE, TJ, TF, TG, TH AND TL SERIES)
SAUER/DANFOSS STEERING UNIT TYPE OSPM SERVICE MANUAL

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Specifications

Item	Description
Piston (Traction) Pump Maximum Pump Displacement (per revolution)	Variable displacement piston pump (Eaton model 70160) 1.44 in^3 (23.6 cc)
Gear Pump Displacement (per revolution)	Single section, positive displacement gear pump (Casappa) 0.30 in^3 (4.95 cc)
Charge Circuit Relief Pressure	110 to 150 PSI (7.6 to 10.3 bar)
Traction Circuit Relief Pressure Forward Reverse	 3000 PSI (207 bar) 3000 PSI (207 bar)
Front Wheel Motors Displacement (per revolution)	Orbital rotor motor (Parker TF Series) 10.3 in^3 (169 cc)
Rear Wheel Motor (Optional 3WD Kit) Displacement (per revolution)	Orbital rotor motor (Parker TG Series) 20.6 in^3 (337 cc)
Power Steering Valve Displacement (per revolution)	Hydrostatic Steering Unit (Sauer-Danfoss Type OSPMS) 4.5 in^3 (74 cc)
Steering/Lift Circuit Relief Pressure	1160 PSI (80 bar)
Hydraulic Filter	Spin-on cartridge type
Hydraulic Oil	See Operator's Manual
Hydraulic Reservoir Capacity Standard Machine Machine with Optional Turf Defender^{TM} Leak Detector	 5.5 gal. U.S. (20.8 L) 6.8 gal. U.S. (25.7 L)

General Information

Operator’s Manuals

The Traction Unit and Cutting Unit Operator’s Manuals provide information regarding the operation, general maintenance procedures and maintenance intervals for your Greensmaster machine. Refer to these publications for additional information when servicing the machine.

Check Hydraulic Fluid Level

The hydraulic system on your Greensmaster machine is designed to operate on high quality hydraulic fluid. **Check level of hydraulic fluid daily.** Refer to Traction Unit Operator’s Manual for fluid level checking procedure and hydraulic oil recommendations.

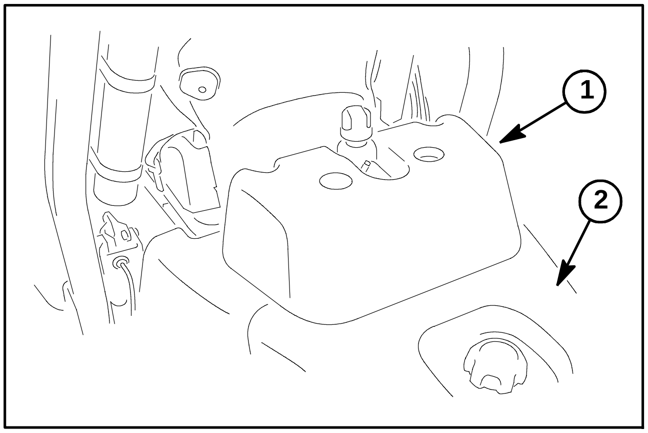


Figure 1

1. **Hydraulic reservoir**
2. **Fuel tank**

Pushing Traction Unit

In case of emergency, your Greensmaster can be pushed for a very short distance. However, Toro does not recommend this as a standard procedure.

1. Make sure that engine is not running.

2. Locate by–pass valve on piston (traction) pump (Fig. 2). Rotate by–pass valve so slot is vertical.

IMPORTANT: Do not push the machine faster than 2 mph because the traction system may be damaged. If machine must be moved a considerable distance (more than a few feet), transport it on a truck or trailer.

3. Slowly push machine.

4. Before starting engine, rotate by–pass valve so slot is horizontal. Do not start engine when by–pass valve is in the vertical position.

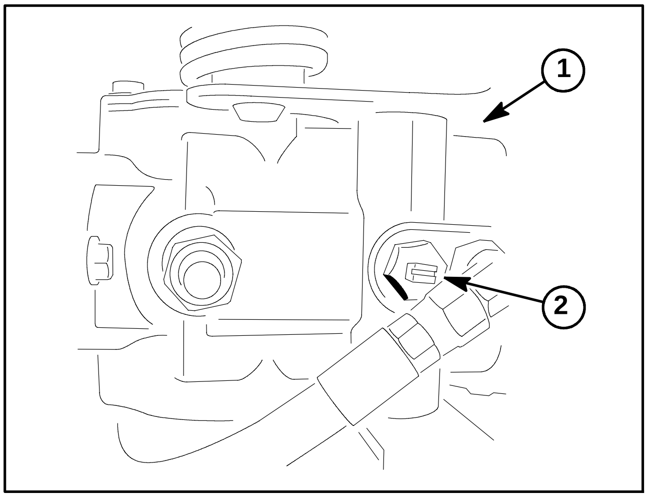


Figure 2

1. **Piston (traction) pump**
2. **By–pass valve**

Relieving Hydraulic System Pressure

Before disconnecting or performing any work on your Greensmaster hydraulic system, all pressure in the hydraulic system must be relieved.

To relieve hydraulic pressure in the traction circuit, park machine on a level surface with the cutting units lowered and off. Turn ignition switch to OFF and allow engine to stop. If machine is parked on an incline or slope, pressure in the traction circuit WILL NOT be relieved.

To relieve hydraulic pressure in lift circuit, fully lower the cutting units to the ground. Turn ignition switch to OFF and allow engine to stop. Make sure that after lowering, none of the cutting units are not being supported by the lift cylinders.

To relieve hydraulic pressure in the steering circuit, park machine on a level surface with the cutting units lowered and off. Turn ignition switch to OFF. After engine has come to a complete stop, rotate steering wheel in both directions.

Opening Electrical Circuit to Cutting Units

CAUTION

Before installing, removing or servicing the cutting units, separate the cutting unit power disconnect. This will prevent unexpected cutting unit operation.

Before installing, removing or working on the cutting units, disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (Fig. 3). The couplers are located at the base of the rollover bar on the left side of the traction unit. Connect the couplers together before operating the machine.

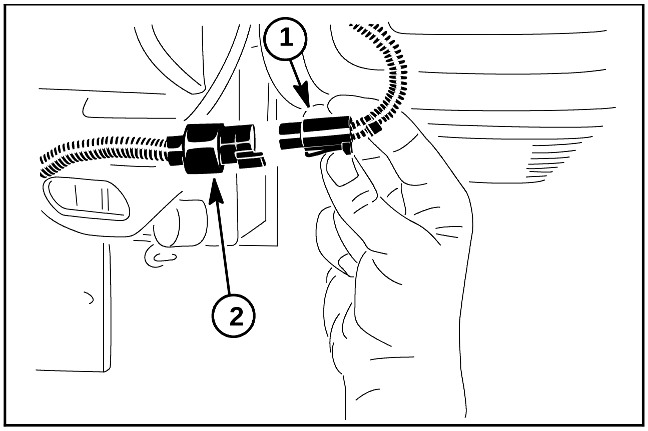


Figure 3

1. **Coupler**
2. **Stationary coupler**

Traction Circuit Component Failure

The traction circuit on your Greensmaster machine is a closed loop system that includes the piston (traction) pump and two (2) wheel motors (three (3) wheel motors are included if machine is equipped with optional 3WD kit). If a component in the traction circuit should fail, debris and contamination from the failed component will circulate throughout the traction circuit. This contamination can damage other components in the circuit so it must be removed to prevent additional component failure.

The recommended method of removing traction circuit contamination would be to temporarily install the Toro high flow hydraulic filter (see Special Tools in this chapter) into the circuit. This filter should be used when connecting hydraulic test gauges in order to test traction circuit components or after replacing a failed traction circuit component (e.g. traction (piston) pump or wheel motor). The filter will ensure that contaminates are removed from the closed loop and thus, do not cause additional component damage.

Once the Toro high flow hydraulic filter kit has been placed in the circuit, raise and support the machine with all drive wheels off the ground. Then, operate the traction circuit to allow oil flow throughout the circuit. The filter will remove contamination from the traction circuit during operation. Because the Toro high flow filter is bi-directional, the traction circuit can be operated in both the forward and reverse direction. The filter should be removed from the machine after contamination has been removed from the traction circuit. See Filtering Closed-Loop Traction Circuit in the Service and Repairs section of this chapter for additional information on using the Toro high flow hydraulic filter.

The alternative to using the Toro high flow hydraulic filter kit after a traction circuit component failure would be to disassemble, drain and thoroughly clean all components, tubes and hoses in the traction circuit. If any debris remains in the traction circuit and the machine is operated, the debris can cause additional circuit component failure.

Hydraulic Hoses

Hydraulic hoses are subject to extreme conditions such as pressure differentials during operation and exposure to weather, sun, chemicals, very warm storage conditions or mishandling during operation and maintenance. These conditions can cause hose damage and deterioration. Some hoses are more susceptible to these conditions than others. Inspect all machine hydraulic hoses frequently for signs of deterioration or damage:

Hard, cracked, cut, abraded, charred, leaking or otherwise damaged hose.

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint (layline) on the hose. Use two wrenches; hold the hose straight with one wrench and tighten the hose swivel nut onto the fitting with the other wrench (see Hydraulic Hose and Tube Installation in this section). If the hose has an elbow at one end, tighten the swivel nut on that end before tightening the nut on the straight end of the hose.

For additional hydraulic hose information, refer to Toro Service Training Book, Hydraulic Hose Servicing (Part Number 94813SL).

WARNING

Before disconnecting or performing any work on hydraulic system, relieve all pressure in system (see Relieving Hydraulic System Pressure in this section).

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

Hydraulic Hose and Tube Installation (O-Ring Face Seal Fitting)

1. Make sure threads and sealing surfaces of the hose/tube and the fitting are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the face seal O-ring be replaced any time the connection is opened. Make sure the O-ring is installed and properly seated in the fitting groove. Lightly lubricate the O-ring with clean hydraulic oil.

3. Place the hose/tube against the fitting body so that the flat face of the hose/tube sleeve fully contacts the O-ring in the fitting.

4. Thread the swivel nut onto the fitting by hand. While holding the hose/tube with a wrench, use a torque wrench to tighten the swivel nut to the recommended installation torque shown in Figure 6. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 - Product Records and Maintenance).

5. If a torque wrench is not available or if space at the swivel nut prevents use of a torque wrench, an alternate method of assembly is the Flats From Wrench Resistance (F.F.W.R.) method (Fig. 2).

   A. Using a wrench, tighten the swivel nut onto the fitting until light wrench resistance is reached (approximately 30 in-lb).

   B. Mark the swivel nut and fitting body. Hold the hose/tube with a wrench to prevent it from turning.

   C. Use a second wrench to tighten the nut to the correct Flats From Wrench Resistance (F.F.W.R.). The markings on the nut and fitting body will verify that the connection has been properly tightened.

Fitting Size	F.F.W.R.
4 (1/4 in. nominal hose or tubing)	1/2 to 3/4
6 (3/8 in.)	1/2 to 3/4
8 (1/2 in.)	1/2 to 3/4
10 (5/8 in.)	1/2 to 3/4
12 (3/4 in.)	1/3 to 1/2
16 (1 in.)	1/3 to 1/2

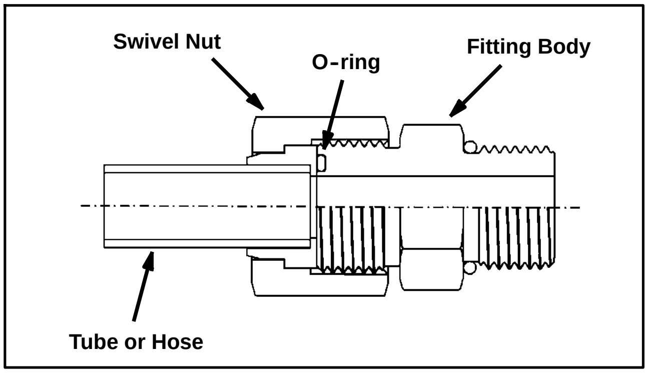


Figure 4

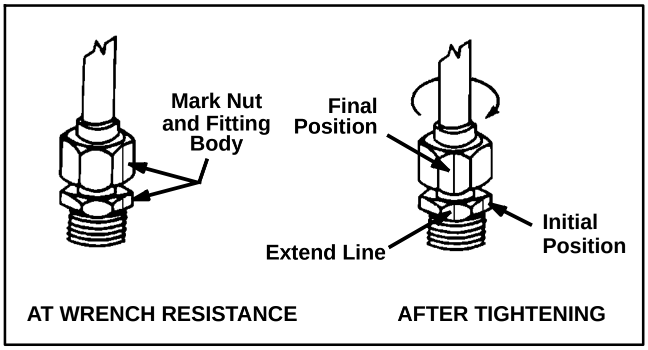


Figure 5

Fitting Dash Size	Hose/Tube Side Thread Size	Installation Torque
4	9/16 - 18	18 to 22 ft-lb (25 to 29 N-m)
6	11/16 - 16	27 to 33 ft-lb (37 to 44 N-m)
8	13/16 - 16	37 to 47 ft-lb (51 to 63 N-m)
10	1 - 14	60 to 74 ft-lb (82 to 100 N-m)
12	1 3/16 - 12	85 to 105 ft-lb (116 to 142 N-m)
16	1 7/16 - 12	110 to 136 ft-lb (150 to 184 N-m)
20	1 11/16 - 12	140 to 172 ft-lb (190 to 233 N-m)

Figure 6

Hydraulic Fitting Installation (SAE Straight Thread O-Ring Fitting into Component Port)

Non-Adjustable Fitting (Fig. 7)

1. Make sure all threads and sealing surfaces of fitting and component port are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the O-ring be replaced any time the connection is opened.

3. Lightly lubricate the O-ring with clean hydraulic oil. Fitting threads should be clean with no lubricant applied.

IMPORTANT: Before installing fitting into port, determine port material. If fitting is to be installed into an aluminum port, installation torque is reduced.

4. Install the fitting into the port. Then, use a torque wrench and socket to tighten the fitting to the recommended installation torque shown in Figure 8.

NOTE: Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be less than the recommended installation torque. See Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 - Product Records and Maintenance to determine necessary conversion information.

5. If a torque wrench is not available, or if space at the port prevents use of a torque wrench, an alternate method of assembly is the Flats From Finger Tight (F.F.F.T.) method.

A. Install the fitting into the port and tighten it down full length until finger tight.

B. If port material is steel, tighten the fitting to the listed F.F.F.T. If port material is aluminum, tighten fitting to 60% of listed F.F.F.T.

Fitting Size	**F.F.F.T.**
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

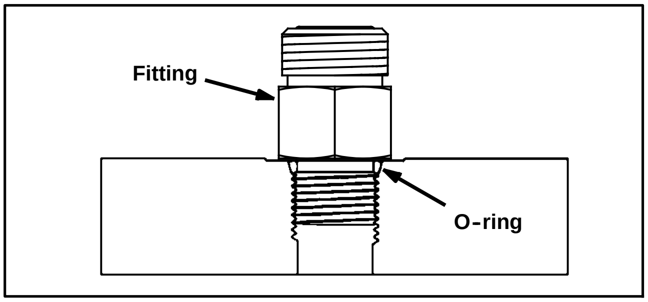


Figure 7

Fitting Dash Size	Fitting Port Side Thread Size	Installation Torque Into Steel Port	Installation Torque Into Aluminum Port
4	7/16 - 20	15 to 19 ft-lb (21 to 25 N-m)	9 to 11 ft-lb (13 to 15 N-m)
5	1/2 - 20	18 to 22 ft-lb (25 to 29 N-m)	11 to 15 ft-lb (15 to 20 N-m)
6	9/16 - 18	34 to 42 ft-lb (47 to 56 N-m)	20 to 26 ft-lb (28 to 35 N-m)
8	3/4 - 16	58 to 72 ft-lb (79 to 97 N-m)	35 to 43 ft-lb (48 to 58 N-m)
10	7/8 - 14	99 to 121 ft-lb (135 to 164 N-m)	60 to 74 ft-lb (82 to 100 N-m)
12	1 1/16 - 12	134 to 164 ft-lb (182 to 222 N-m)	81 to 99 ft-lb (110 to 134 N-m)
14	1 3/16 - 12	160 to 196 ft-lb (217 to 265 N-m)	96 to 118 ft-lb (131 to 160 N-m)
16	1 5/16 - 12	202 to 248 ft-lb (274 to 336 N-m)	121 to 149 ft-lb (165 to 202 N-m)
20	1 5/8 - 12	247 to 303 ft-lb (335 to 410 N-m)	149 to 183 ft-lb (202 to 248 N-m)

Figure 8

Adjustable Fitting (Fig. 9)

1. Make sure all threads and sealing surfaces of fitting and component port are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the O–ring be replaced any time the connection is opened.

3. Lightly lubricate the O–ring with clean hydraulic oil. Fitting threads should be clean with no lubricant applied.

4. Turn back the lock nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1 in Figure 10).

IMPORTANT: Before installing fitting into port, determine port material. If fitting is to be installed into an aluminum port, installation torque is reduced.

5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2).

6. To put the fitting in the desired position, unscrew it by the required amount, but no more than one full turn (Step 3).

7. Hold the fitting in the desired position with a wrench and use a torque wrench to tighten the fitting to the recommended installation torque shown in Figure 8. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 – Product Records and Maintenance).

8. If a torque wrench is not available, or if space at the port prevents use of a torque wrench, an alternate method of assembly is the Flats From Finger Tight (F.F.F.T.) method. Hold the fitting in the desired position with a wrench and, if port material is steel, tighten the lock nut with a second wrench to the listed F.F.F.T. (Step 4). If port material is aluminum, tighten fitting to 60% of listed F.F.F.T.

Fitting Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

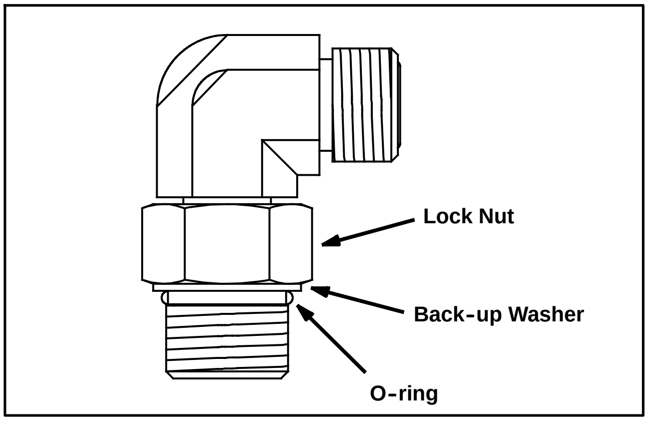


Figure 9

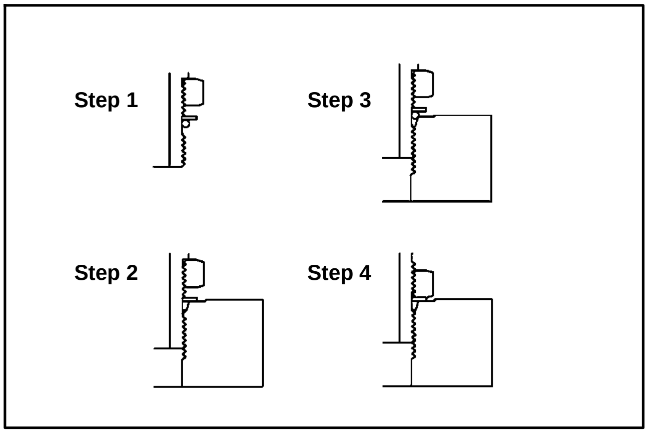
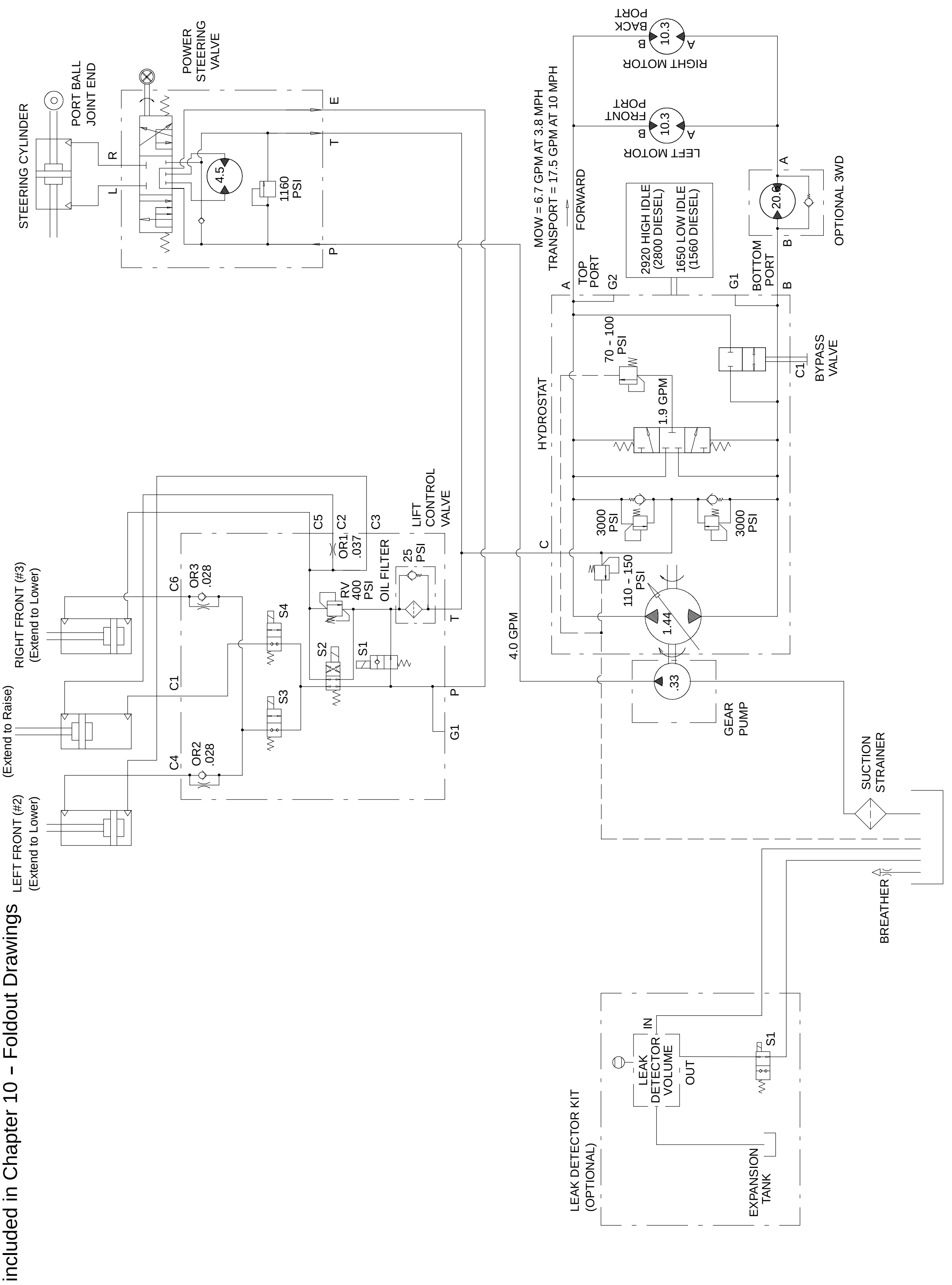


Figure 10


STEERING CYLINDER
PORT BALL JOINT END
POWER STEERING VALVE
R
L
E
T
P
4.5
1160 PSI
RIGHT FRONT (#3) (Extend to Lower)
CENTER (#1) (Extend to Raise)
LEFT FRONT (#2) (Extend to Lower)
C6
C1
C4
C5
C2
C3
OR3 .028
OR2 .028
OR1 .037
S4
S3
S2
S1
RV 400 PSI
OIL FILTER
25 PSI
LIFT CONTROL VALVE
T
P
G1
4.0 GPM
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
FORWARD
RIGHT MOTOR
10.3
BACK PORT
LEFT MOTOR
10.3
FRONT PORT
A
B
OPTIONAL 3WD
20.6
2920 HIGH IDLE (2800 DIESEL)
1650 LOW IDLE (1560 DIESEL)
TOP PORT
G2
G1
BOTTOM PORT
A
B
70 - 100 PSI
HYDROSTAT
1.9 GPM
BYPASS VALVE
C1
3000 PSI
3000 PSI
C
110 - 150 PSI
1.44
.33
GEAR PUMP
SUCTION STRAINER
BREATHER
LEAK DETECTOR KIT (OPTIONAL)
IN
OUT
LEAK DETECTOR VOLUME
S1
EXPANSION TANK

NOTE: A larger hydraulic schematic is included in Chapter 10 – Foldout Drawings

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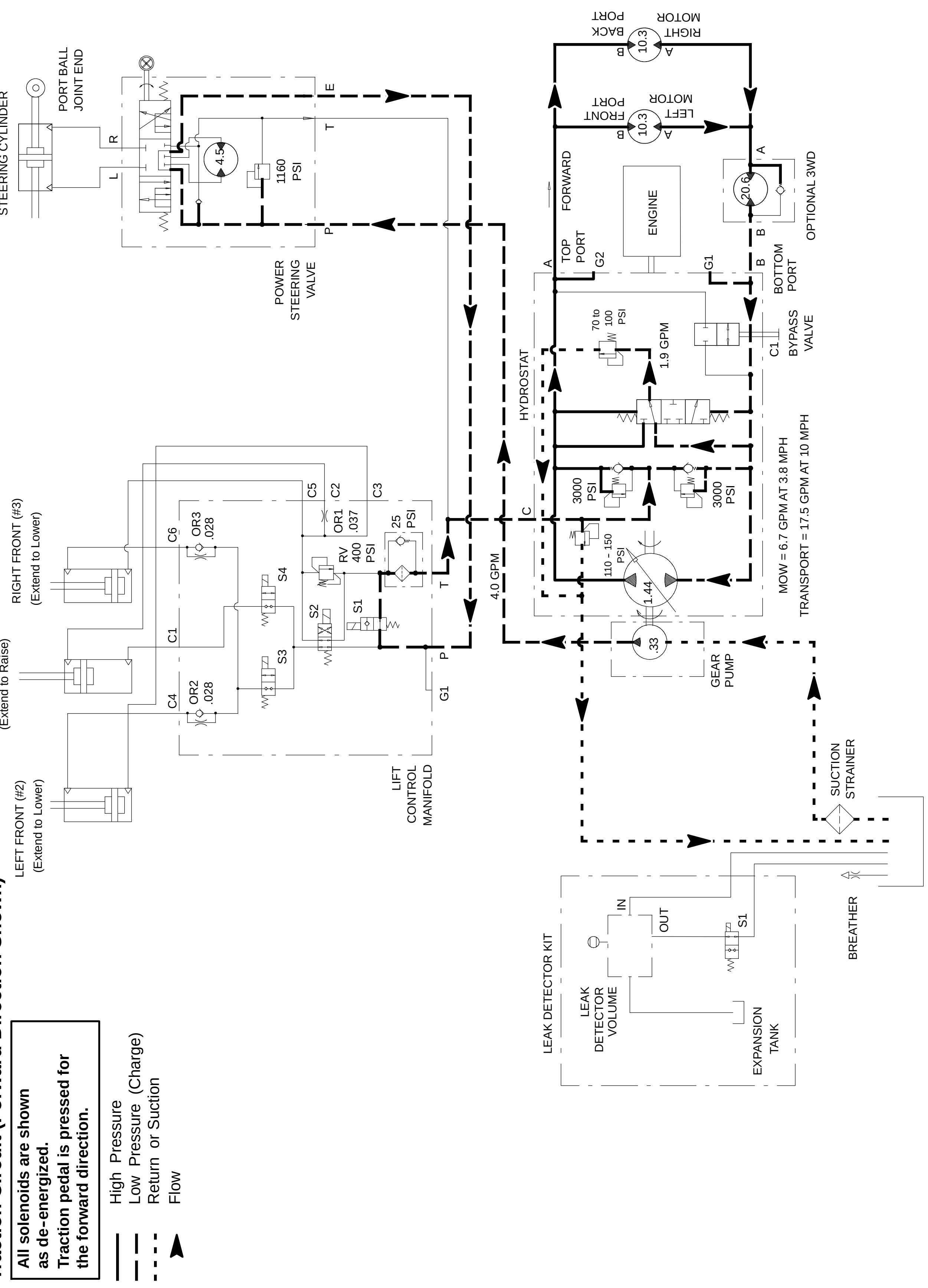
Hydraulic Flow Diagrams


STEERING CYLINDER
PORT BALL JOINT END
R
L
E
T
P
4.5
1160 PSI
POWER STEERING VALVE
RIGHT MOTOR
BACK PORT
LEFT MOTOR
FRONT PORT
10.3
A
B
FORWARD
ENGINE
TOP PORT
G2
G1
BOTTOM PORT
20.6
OPTIONAL 3WD
70 to 100 PSI
1.9 GPM
BYPASS VALVE
C1
HYDROSTAT
3000 PSI
C
110 - 150 PSI
1.44
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
4.0 GPM
.33
GEAR PUMP
SUCTION STRAINER
BREATHER
RIGHT FRONT (#3)
(Extend to Lower)
CENTER (#1)
(Extend to Raise)
LEFT FRONT (#2)
(Extend to Lower)
C5
C2
C3
C6
OR3 .028
OR1 .037
25 PSI
RV 400 PSI
S4
S2
S1
S3
C1
C4
OR2 .028
T
P
G1
LIFT CONTROL MANIFOLD
LEAK DETECTOR KIT
IN
OUT
S1
LEAK DETECTOR VOLUME
EXPANSION TANK
High Pressure
Low Pressure (Charge)
Return or Suction
Flow

Greensmaster 3320/3420

Traction Circuit (Forward Direction Shown)

All solenoids are shown as de-energized.

Traction pedal is pressed for the forward direction.

Traction Circuit

The traction circuit piston pump is a variable displacement pump that is directly coupled to the engine. Pushing the traction pedal controls the variable displacement piston pump swash plate to create a flow of oil. This oil is directed to the wheel motors. Operating pressure on the high pressure side of the closed traction circuit loop is determined by the amount of load developed at the fixed displacement wheel motors. As the load increases, circuit pressure can increase to relief valve settings: 3000 PSI (207 bar) in both forward and reverse. If pressure exceeds the relief setting, oil flows through the relief valve to the low pressure side of the closed loop traction circuit.

The traction circuit pump and wheel motors use a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across traction pump and motor components into the case drain. This leakage results in the loss of hydraulic fluid from the closed loop traction circuit that must be replaced. The charge circuit is designed to replace this traction circuit leakage.

The gear pump that supplies oil to the steering and lift circuits also provides charge circuit oil. This gear pump is driven directly off the piston (traction) pump. It provides a constant supply of charge oil to the traction circuit to make up for oil that is lost due to internal leakage in the traction pump and wheel motors.

Charge pump flow is directed to the low pressure side of the closed loop traction circuit. Charge circuit pressure (110 to 150 PSI / 7.6 to 10.3 bar) is maintained by the charge relief valve that is attached to the piston pump back plate.

The functional control lever on Greensmaster TriFlex Hybrid machines has positions for neutral, mow and transport. When the functional control lever is in the neutral position, the traction pedal is secured in the neutral position. The mow position allows traction pedal inputs that are appropriate for mow speeds by limiting the movement of the piston pump swash plate. The transport position allows full movement of the traction pedal so complete pump swash rotation is possible.

Forward

The piston (traction) pump is driven directly by the engine. The hydraulic traction circuit acts essentially as a closed loop. Taking its suction directly from the return side of the wheel motors of the traction circuit, the piston pump supplies oil flow to the wheel motors through the supply side of the traction circuit.

With the engine running and traction pedal in the neutral position, the piston pump supplies no flow to the wheel motors. When the traction pedal is pressed to the forward position, the linkage from the pedal positions the swash plate in the piston pump so oil flows out the top port of the pump. Oil flow out of the top port goes to the wheel motors and turns them in the forward direction.

Oil flowing out of the wheel motors returns to the bottom port of the piston pump and is continuously pumped out the top port.

Reverse

The traction circuit operates essentially the same in reverse as it does in the forward direction. However, the flow through the circuit is reversed.

With the engine running and traction pedal in the neutral position, the piston pump supplies no flow to the wheel motors. When the traction pedal is pressed to the reverse position, the linkage from the pedal positions the swash plate in the piston pump so oil flows out the bottom port of the pump. Oil flow out of the bottom port goes to the wheel motors and turns them in the reverse direction.

Oil flowing out of the wheel motors returns to the top port of the piston pump and is continuously pumped out the bottom port.

Traction Circuit Cooling

The piston pump includes a shuttle valve that bleeds off a small amount of hydraulic fluid for cooling of the closed loop traction circuit. This valve allows a small amount of hydraulic oil to pass from the low pressure side of the traction circuit while operating the traction unit in either direction. A relief valve in the piston pump back plate prevents shuttle valve bleed off until the relief valve opens (70 to 100 PSI / 4.9 to 6.8 bar). The charge circuit replenishes oil that is bled from the traction circuit by the shuttle valve.

NOTE: The shuttle valve assembly is located in the piston pump back plate. Access to the shuttle valve requires removal of the back plate from the piston pump.

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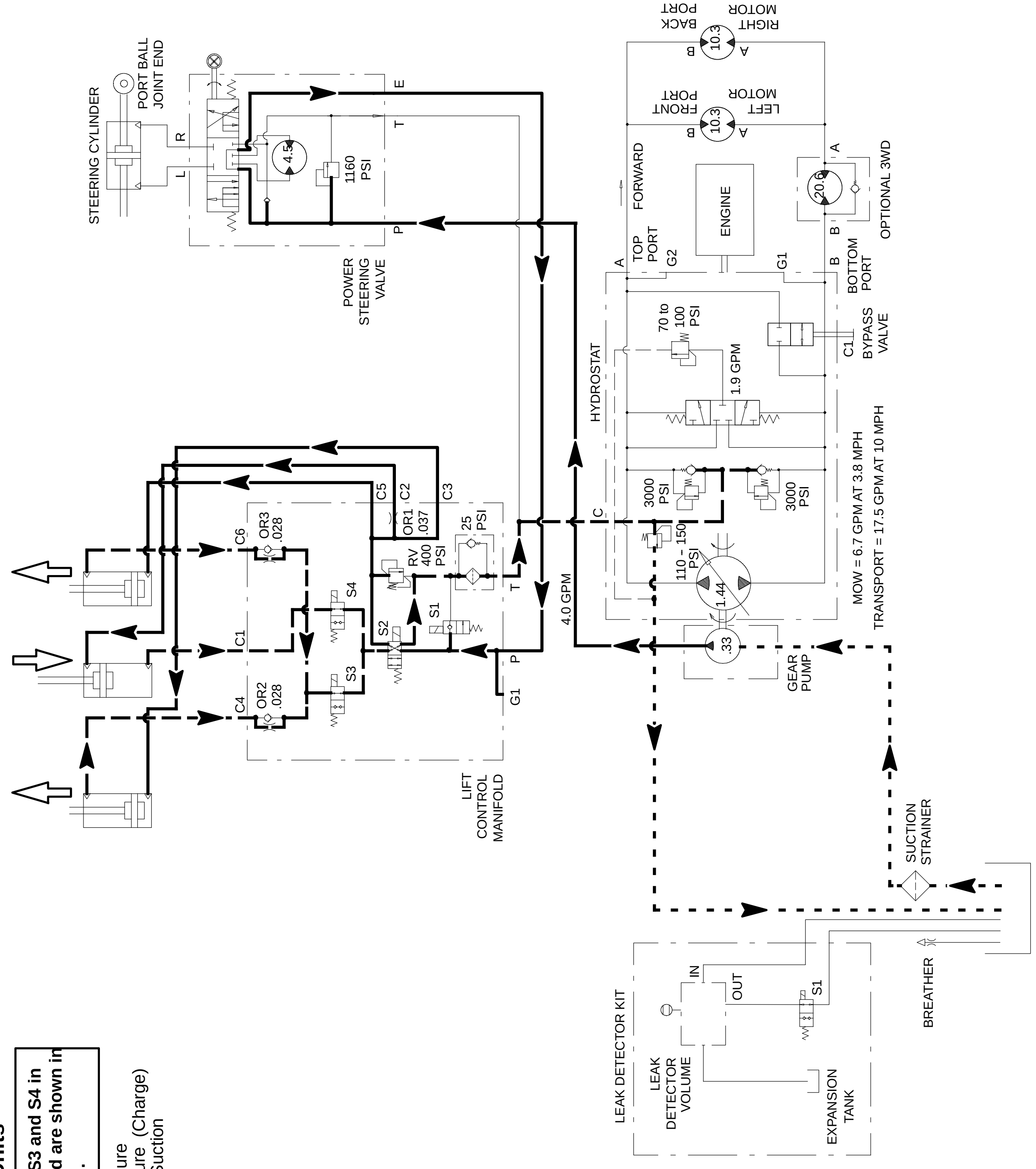
Lower Cutting Units

Solenoids S1, S2, S3 and S4 in lift control manifold are shown in energized position.


STEERING CYLINDER
PORT BALL JOINT END
L
R
4.5
1160 PSI
E
T
P
POWER STEERING VALVE
RIGHT FRONT (#3) (Extend to Lower)
CENTER (#1) (Extend to Raise)
LEFT FRONT (#2) (Extend to Lower)
C5
C2
C3
C6
OR3 .028
OR1 .037
25 PSI
RV 400 PSI
S4
S1
S2
C1
S3
C4
OR2 .028
T
P
G1
LIFT CONTROL MANIFOLD
4.0 GPM
C
HYDROSTAT
A
TOP PORT
G2
FORWARD
ENGINE
G1
B
BOTTOM PORT
70 to 100 PSI
1.9 GPM
C1
BYPASS VALVE
3000 PSI
3000 PSI
110 - 150 PSI
1.44
.33
GEAR PUMP
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
A
B
20.6
OPTIONAL 3WD
B
A
10.3
LEFT MOTOR
FRONT PORT
B
A
10.3
RIGHT MOTOR
BACK PORT
SUCTION STRAINER
BREATHER
LEAK DETECTOR KIT
IN
OUT
S1
LEAK DETECTOR VOLUME
EXPANSION TANK

━ High Pressure

╍ Low Pressure (Charge)

┅ Return or Suction

▲ Flow

Lower Cutting Units

The gear pump is directly coupled to the piston (traction) pump. The gear pump supplies hydraulic flow for the steering circuit (priority flow), for raising and lowering the cutting units and for the traction charge circuit. The gear pump takes its suction from the hydraulic reservoir. Maximum circuit pressure of 1160 PSI (80 bar) is limited by the relief valve located in the power steering valve.

The lift control manifold includes four (4) electrically operated solenoid valves. Solenoid valve S1 causes circuit flow to by-pass the lift cylinders when de-energized and directs flow to the cylinders when energized. Directional solenoid valve S2 is used to direct oil flow to raise the cutting units when de-energized and lower them when energized. When energized, solenoid valve S3 allows hydraulic flow to and from the front cutting unit lift cylinders (#2 and #3) and prevents oil passage to and from the lift cylinders when de-energized. When energized, solenoid valve S4 allows hydraulic flow to and from the center cutting unit lift cylinder (#1) and prevents oil passage to and from the lift cylinder when de-energized.

The console arm joystick is used to raise and lower the cutting units. The joystick acts as an input to the TEC controller to send electrical outputs to appropriate lift control manifold solenoid coils in order to raise or lower the cutting units.

While operating the machine during conditions of not raising or lowering the cutting units (joystick in the neutral (center) position), all of the lift manifold solenoid valves (S1, S2, S3 and S4) are de-energized. Flow from the gear pump is directed through the power steering valve, de-energized solenoid valve S1 in the lift control manifold, oil filter and to the traction charge circuit. Flow in excess of charge circuit needs then returns to the gear pump input.

Lower Cutting Units

When the joystick is moved to the lower position, the Toro Electronic Controller (TEC) energizes all of the lift control manifold solenoid valves for approximately three (3) seconds. This time frame ensures that the cutting units will be fully lowered to allow them to float during operation. The controller also provides a short delay in energizing solenoid valve S4 which delays the lowering of the center cutting unit (#1).

Energized lift manifold solenoids S1 and S2 direct circuit flow toward the lift cylinders in the correct direction to lower the cutting units. The front lift cylinders extend to lower the cutting units while the center lift cylinder retracts to lower the cutting unit. Hydraulic pressure against the lift cylinder pistons moves their shafts causing the cutting units to lower. At the same time, the lift cylinder pistons push the hydraulic fluid out of the cylinders to energized solenoid valves S3 (front lift cylinders) and S4 (center lift cylinder). Return flow continues through energized solenoid valve S2, to the oil filter and then to the traction charge circuit.

Lowering speed for each of the front cutting units (#2 and #3) is controlled by a 0.028 orifice (OR2 and OR3) in the lift control manifold. A 0.037 orifice (OR1) controls lowering speed for the center cutting unit (#1).

If the lift cylinders should reach the end of their stroke while the lift manifold solenoids are still energized, lift circuit pressure will increase. The lift circuit lower relief valve (RV) in the lift control manifold allows lift circuit pressure to be limited to 400 PSI (27.6 bar) while lowering the cutting units.

NOTE: Adjustment of the lift control manifold lift circuit lower relief valve (RV) is not recommended.

When the lift control manifold solenoid valves are de-energized by the TEC controller, spring action returns the valves to their original position stopping lift cylinder movement. The lift cylinder position is locked in place since there is no complete circuit of flow to and from the lift cylinders. Hydraulic flow by-passes the lift cylinders and is routed to the oil filter and charge circuit.

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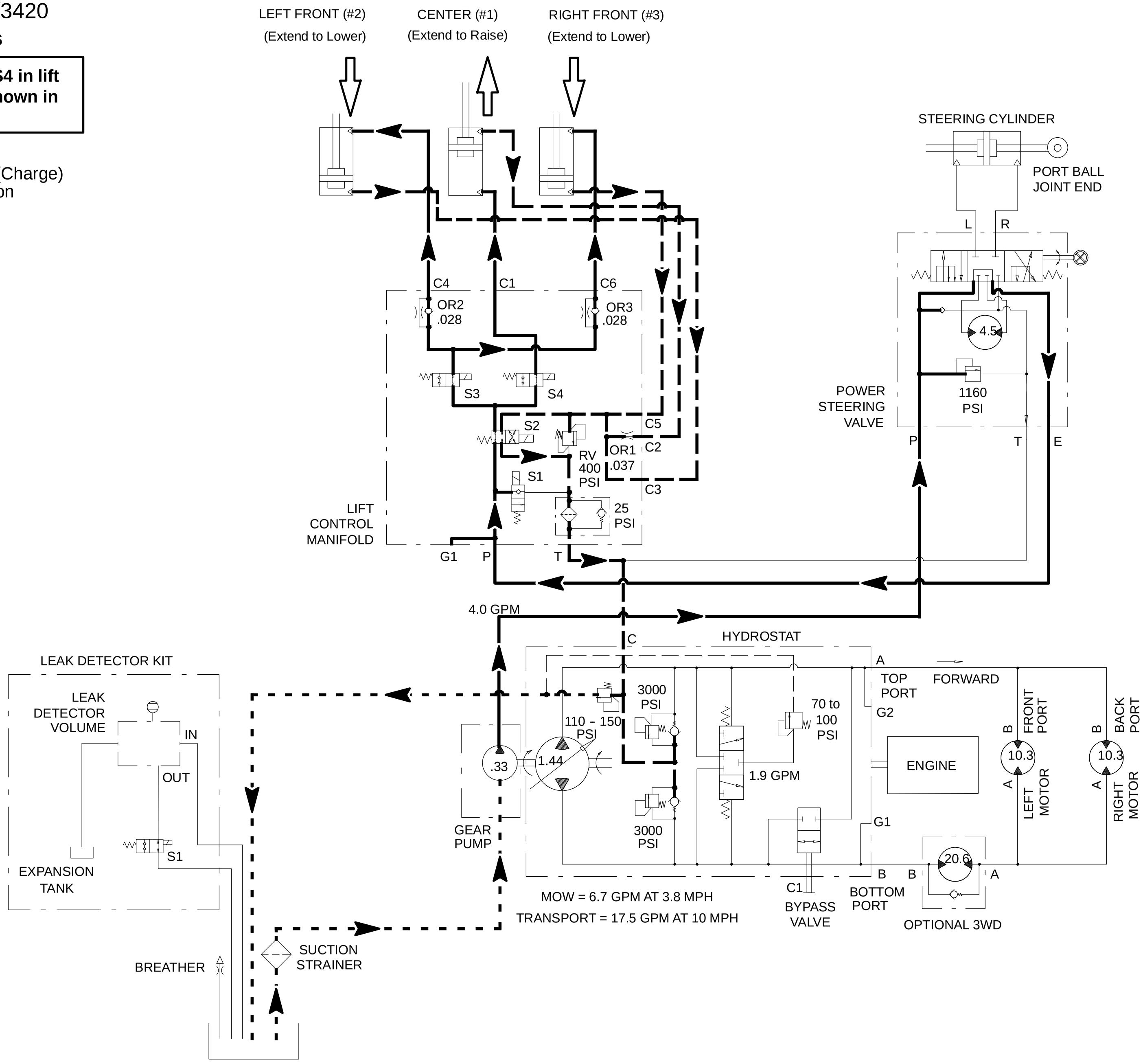
Raise Cutting Units

Solenoids S1, S3 and S4 in lift control manifold are shown in energized position.

—— High Pressure
— — Low Pressure (Charge)
- - - Return or Suction
➤ Flow


LEFT FRONT (#2)
(Extend to Lower)
CENTER (#1)
(Extend to Raise)
RIGHT FRONT (#3)
(Extend to Lower)
STEERING CYLINDER
PORT BALL
JOINT END
L
R
C4
C1
C6
OR2
.028
OR3
.028
S3
S4
S2
RV
400
PSI
OR1
.037
C5
C2
C3
S1
25
PSI
LIFT
CONTROL
MANIFOLD
G1
P
T
POWER
STEERING
VALVE
4.5
1160
PSI
P
T
E
4.0 GPM
C
HYDROSTAT
A
TOP
PORT
FORWARD
G2
LEAK DETECTOR KIT
LEAK
DETECTOR
VOLUME
IN
OUT
S1
EXPANSION
TANK
3000
PSI
110 – 150
PSI
1.44
.33
70 to
100
PSI
1.9 GPM
3000
PSI
GEAR
PUMP
ENGINE
G1
B
FRONT
PORT
10.3
A
LEFT
MOTOR
B
BACK
PORT
10.3
A
RIGHT
MOTOR
B
B
20.6
A
C1
BYPASS
VALVE
BOTTOM
PORT
OPTIONAL 3WD
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
BREATHER
SUCTION
STRAINER

Raise Cutting Units

The gear pump is directly coupled to the piston (traction) pump. The gear pump supplies hydraulic flow for the steering circuit (priority flow), for raising and lowering the cutting units and for the traction charge circuit. The gear pump takes its suction from the hydraulic reservoir. Maximum circuit pressure of 1160 PSI (80 bar) is limited by the relief valve located in the power steering valve.

The lift control manifold includes four (4) electrically operated solenoid valves. Solenoid valve S1 causes circuit flow to by–pass the lift cylinders when de–energized and directs flow to the cylinders when energized. Directional solenoid valve S2 is used to direct oil flow to raise the cutting units when de–energized and lower them when energized. When energized, solenoid valve S3 allows hydraulic flow to and from the front cutting unit lift cylinders (#2 and #3) and prevents oil passage to and from the lift cylinders when de–energized. When energized, solenoid valve S4 allows hydraulic flow to and from the center cutting unit lift cylinder (#1) and prevents oil passage to and from the lift cylinder when de–energized.

The console arm joystick is used to raise and lower the cutting units. The joystick acts as an input to the TEC controller to send electrical outputs to appropriate lift control manifold solenoid coils in order to raise or lower the cutting units.

While operating the machine during conditions of not raising or lowering the cutting units (joystick in the neutral (center) position), all of the lift manifold solenoid valves (S1, S2, S3 and S4) are de–energized. Flow from the gear pump is directed through the power steering valve, de–energized solenoid valve S1 in the lift control manifold, oil filter and to the traction charge circuit. Flow in excess of charge circuit needs then returns to the gear pump input.

Raise Cutting Units

When the joystick is moved to the raise position, the Toro Electronic Controller (TEC) energizes lift control manifold solenoid valves S1, S3 and S4 for approximately three (3) seconds. This time frame ensures that the cutting units will be fully raised. The controller provides a short delay in energizing solenoid valve S4 which delays the raising of the center cutting unit (#1).

Energized lift manifold solenoids S1, S3 (front lift cylinders) and S4 (center lift cylinder) direct circuit flow toward the lift cylinders in the correct direction to raise the cutting units. The front lift cylinders retract to raise the cutting units while the center lift cylinder extends to raise the cutting unit. Hydraulic pressure against the lift cylinder pistons moves their shafts causing the cutting units to raise. At the same time, the lift cylinder pistons push the hydraulic fluid out of the cylinders to de–energized solenoid valve S2. Return flow continues to the oil filter and then to the traction charge circuit.

A 0.037 orifice (OR1) controls raising speed for the center cutting unit (#1). Flow to the front lift cylinders (cutting units #2 and #3) bypasses the lift manifold orifices (OR2 and OR3) when the front cutting units are being raised.

When the lift control manifold solenoid valves are de–energized by the TEC controller, spring action returns the valves to their original position stopping lift cylinder movement. The lift cylinder position is locked in place since there is no complete circuit of flow to and from the lift cylinders. Hydraulic flow by–passes the lift cylinders and is routed to the oil filter and charge circuit.

NOTE: The raise function will not be allowed by the TEC controller when the machine is in the backlap operation with cutting reels engaged.

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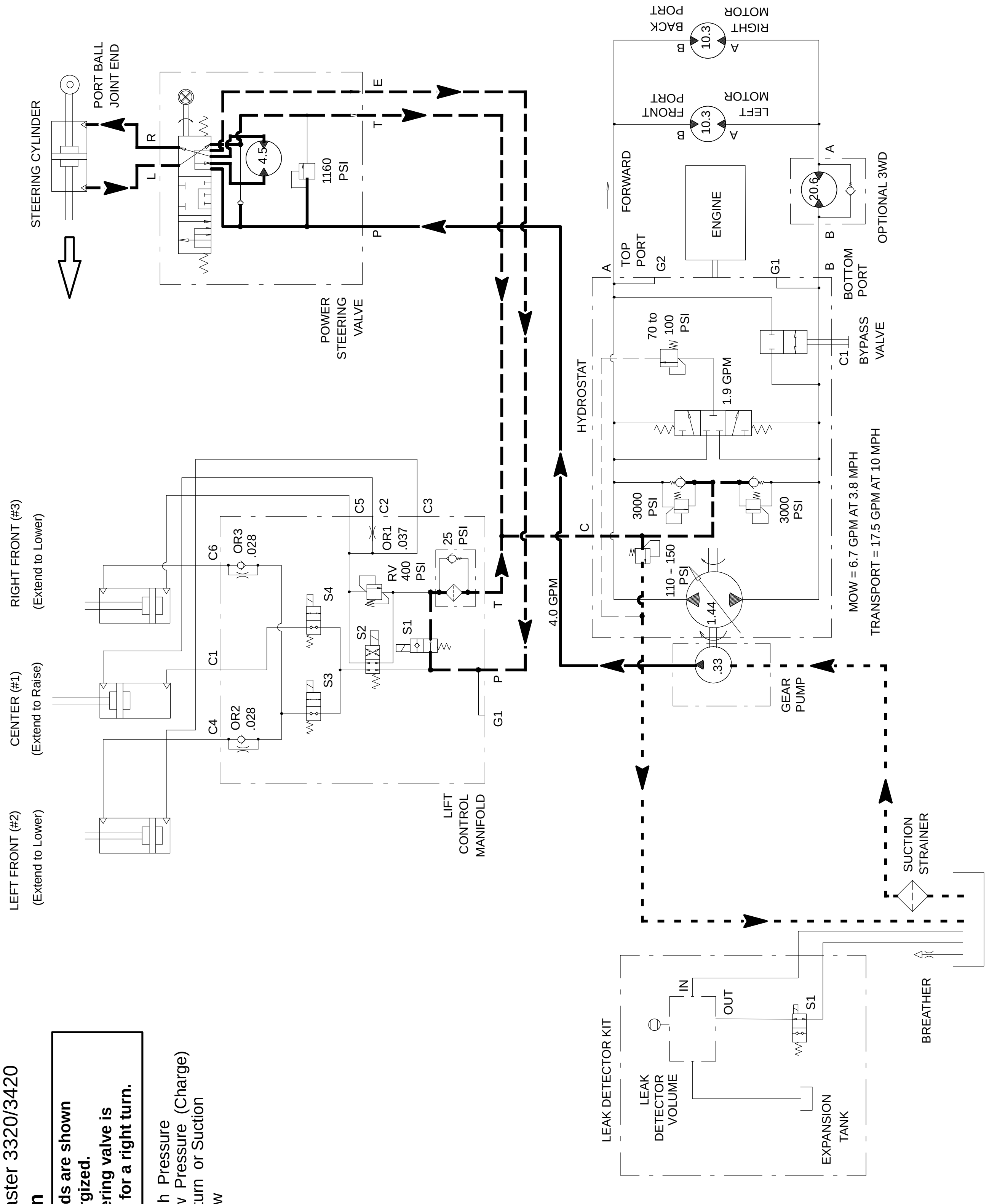
Right Turn

All solenoids are shown as de–energized. Power steering valve is positioned for a right turn.

- High Pressure
- Low Pressure (Charge)
- Return or Suction
- Flow


STEERING CYLINDER
PORT BALL JOINT END
R
L
4.5
1160 PSI
E
T
P
POWER STEERING VALVE
RIGHT FRONT (#3) (Extend to Lower)
CENTER (#1) (Extend to Raise)
LEFT FRONT (#2) (Extend to Lower)
C6
OR3 .028
C5
C2
OR1 .037
C3
25 PSI
RV 400 PSI
S4
S2
S1
T
C1
S3
P
C4
OR2 .028
G1
LIFT CONTROL MANIFOLD
4.0 GPM
C
3000 PSI
3000 PSI
110 – 150 PSI
1.44
.33
GEAR PUMP
HYDROSTAT
70 to 100 PSI
1.9 GPM
C1
BYPASS VALVE
A
TOP PORT
G2
G1
B
BOTTOM PORT
FORWARD
ENGINE
20.6
OPTIONAL 3WD
A
B
10.3
LEFT MOTOR
FRONT PORT
10.3
RIGHT MOTOR
BACK PORT
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
SUCTION STRAINER
BREATHER
LEAK DETECTOR KIT
IN
OUT
S1
LEAK DETECTOR VOLUME
EXPANSION TANK

Right and Left Turn

The gear pump is directly coupled to the piston (traction) pump. The gear pump supplies hydraulic flow for the steering circuit (priority flow), for raising and lowering the cutting units and for the traction charge circuit. The gear pump takes its suction from the hydraulic reservoir. Maximum circuit pressure of 1160 PSI (80 bar) is limited by the relief valve located in the power steering valve.

With the steering wheel in the neutral position (not turned) and the engine running, the power steering valve spool is in the center position. Gear pump flow enters the power steering valve at port (P) and goes through the spool valve, by–passing the steering cylinder. Flow leaves the steering valve from port (E) to be available for the raise/lower and traction charge circuits.

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the power steering valve spool so that gear pump flow goes through the top of the spool. Flow entering the power steering valve at port (P) goes through the spool and is routed to two places. First, most of the flow through the valve is by–passed out port (E) and becomes available for the raise/lower and traction charge circuits. Second, the remainder of the flow is drawn through the steering valve rotary meter and out steering valve port (R). Pressure retracts the steering cylinder for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve, out steering valve port (T) and then to the traction charge circuit.

The power steering valve returns to the neutral position when turning is complete.

Left Turn

When a left turn is made with the engine running, the turning of the steering wheel positions the power steering valve spool so that gear pump flow goes through the bottom of the spool. Flow entering the power steering valve at port (P) goes through the spool and is routed to two places. First, most of the flow through the valve is by–passed out port (E) and becomes available for the raise/lower and traction charge circuits. Second, the remainder of the flow is drawn through the steering valve rotary meter and out steering valve port (L). Pressure extends the steering cylinder for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve, out steering valve port (T) and then to the traction charge circuit.

The power steering valve returns to the neutral position when turning is complete.

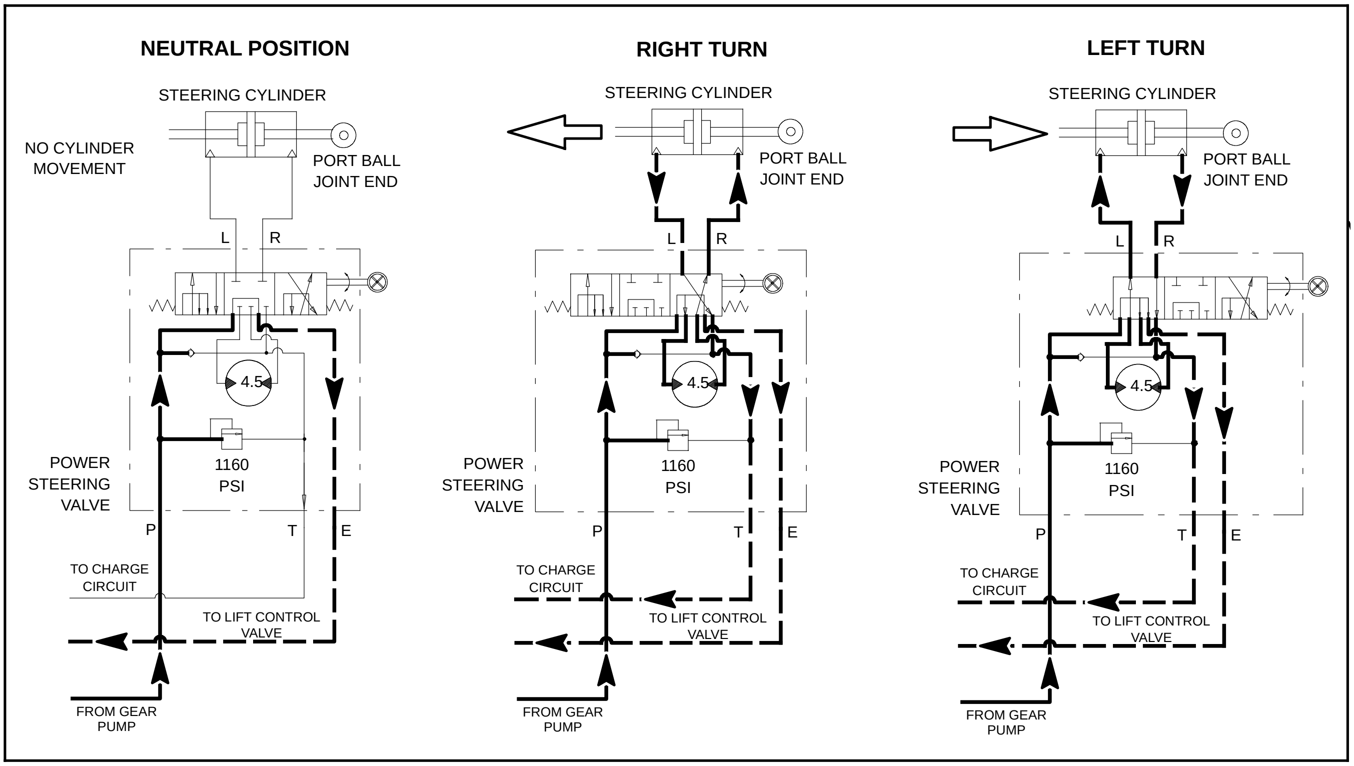


Figure 11

Special Tools

Order these special tools from your Toro Distributor.

Hydraulic Pressure Test Kit

Use to take various pressure readings for diagnostic tests. Quick disconnect fittings provided attach directly to mating fittings on machine test ports without tools. A high pressure hose is provided for remote readings. Contains one each: 1000 PSI (70 Bar), 5000 PSI (350 Bar) and 10000 PSI (700 Bar) gauges. Use gauges as recommended in the Testing section of this chapter.

Toro Part Number: **TOR47009**

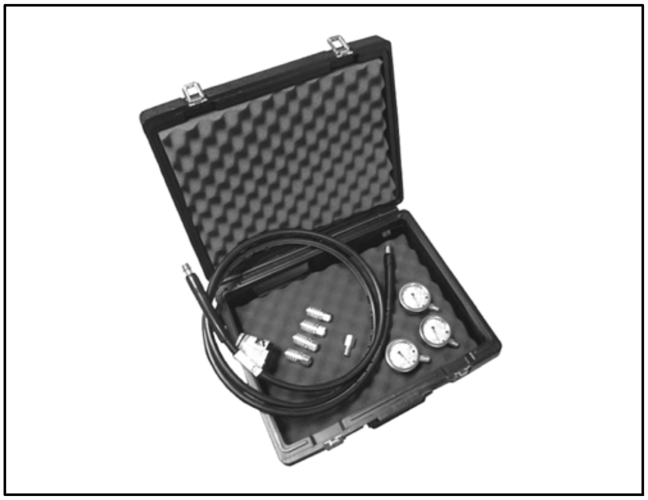


Figure 12

Hydraulic Tester (Pressure and Flow)

This tester requires O–ring Face Seal (ORFS) adapter fittings for use on this machine (see Hydraulic Test Fitting Kit (TOR4079) in this section).

1. INLET HOSE: Hose connected from the system circuit to the inlet side of the hydraulic tester.

2. LOAD VALVE: A simulated working load is created in the circuit by turning the valve to restrict flow.

3. PRESSURE GAUGE: 0 to 5000 PSI gauge to provide operating circuit pressure.

4. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated at 15 GPM.

5. OUTLET HOSE: A hose from the outlet side of the hydraulic tester connects to the hydraulic system circuit.

Toro Part Number: **TOR214678**

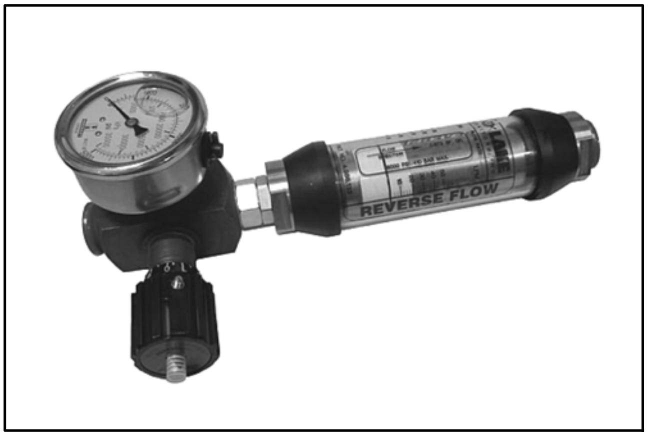


Figure 13

40 GPM Hydraulic Tester (Pressure and Flow)

Use to test hydraulic circuits and components for flow and pressure capacities as recommended in the Testing section of this chapter. This tester includes the following:

1. LOAD VALVE: A simulated working load is created in the circuit by turning the valve to restrict flow.

2. PRESSURE GAUGE: Glycerine filled 0 to 5000 PSI gauge to provide operating circuit pressure.

3. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated from 4 to 40 GPM (20 to 150 LPM).

Toro Part Number: **AT40002**

NOTE: This tester does not include hydraulic hoses (see Hydraulic Hose Kit TOR6007 below).

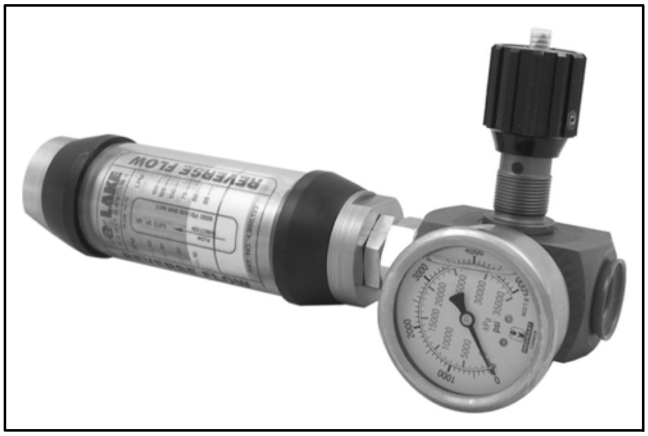


Figure 14

Hydraulic Hose Kit

This kit includes hydraulic fittings and hoses needed to connect 40 GPM hydraulic tester (AT40002) or high flow hydraulic filter kit (TOR6011) to machine hydraulic traction system components.

Toro Part Number: **TOR6007**

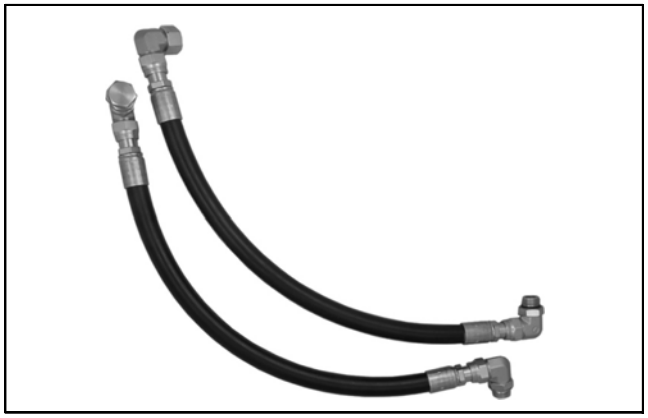


Figure 15

O-ring Kit

The O-ring kit includes O-rings in a variety of sizes for face seal and port seal hydraulic connections. It is recommended that O-rings be replaced whenever a hydraulic connection is loosened.

Toro Part Number: **117-2727**

Figure 16

High Flow Hydraulic Filter Kit

The high flow hydraulic filter kit is designed with large flow (40 GPM/150 LPM) and high pressure (5000 PSI/345 bar) capabilities. This kit provides for bi–directional filtration which prevents filtered debris from being allowed back into the circuit regardless of flow direction.

If a component failure occurs in the closed loop traction circuit, contamination from the failed part will remain in the circuit until removed. When connecting hydraulic test gauges in order to test traction circuit components or after replacing a failed traction circuit component (e.g. piston (traction) pump or wheel motor), the high flow hydraulic filter can be installed in the traction circuit. The filter will ensure that contaminates are removed from the closed loop and thus, do not cause additional component damage.

Toro Part Number: **TOR6011**

NOTE: This kit does not include hydraulic hoses (see Hydraulic Hose Kit TOR6007 above).

NOTE: Replacement filter element is Toro part number TOR6012. Filter element cannister tightening torque is **25 ft–lb (34 N–m)**.

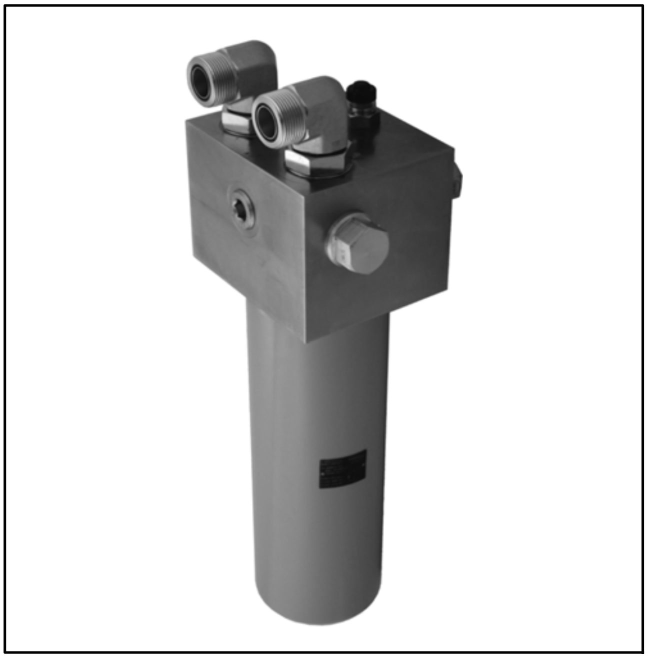


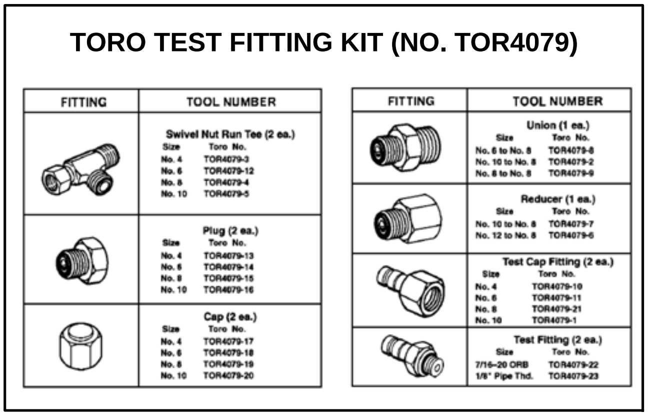
Figure 17

Hydraulic Test Fitting Kit

This kit includes a variety of O–ring face seal fittings to enable you to connect test gauges into the system.

The kit includes: tee's, unions, reducers, plugs, caps and male test fittings.

Toro Part Number: **TOR4079**



TORO TEST FITTING KIT (NO. TOR4079)

FITTING	TOOL NUMBER
	Swivel Nut Run Tee (2 ea.) Size / Toro No. No. 4 TOR4079-3 No. 6 TOR4079-12 No. 8 TOR4079-4 No. 10 TOR4079-5
	Plug (2 ea.) Size / Toro No. No. 4 TOR4079-13 No. 6 TOR4079-14 No. 8 TOR4079-15 No. 10 TOR4079-16
	Cap (2 ea.) Size / Toro No. No. 4 TOR4079-17 No. 6 TOR4079-18 No. 8 TOR4079-19 No. 10 TOR4079-20

FITTING	TOOL NUMBER
	Union (1 ea.) Size / Toro No. No. 6 to No. 8 TOR4079-8 No. 10 to No. 8 TOR4079-2 No. 8 to No. 8 TOR4079-9
	Reducer (1 ea.) Size / Toro No. No. 10 to No. 8 TOR4079-7 No. 12 to No. 8 TOR4079-6
	Test Cap Fitting (2 ea.) Size / Toro No. No. 4 TOR4079-10 No. 6 TOR4079-11 No. 8 TOR4079-21 No. 10 TOR4079-1
	Test Fitting (2 ea.) Size / Toro No. 7/16–20 ORB TOR4079-22 1/8" Pipe Thd. TOR4079-23

Figure 18

Measuring Container

Use this container for doing hydraulic motor efficiency testing (motors with case drain lines only). Measure efficiency of a hydraulic motor by restricting the outlet flow from the motor and measuring leakage from the case drain line while the motor is pressurized by the hydraulic system.

Toro Part Number: **TOR4077**

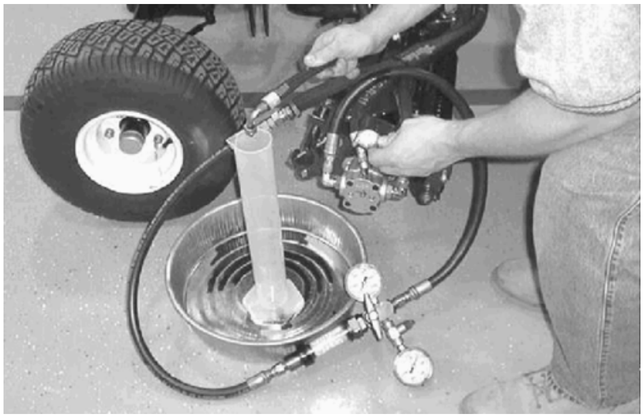


Figure 19

Wheel Hub Puller

The wheel hub puller allows safe removal of the wheel hub from the shaft of wheel motors.

Toro Part Number: **TOR4097**

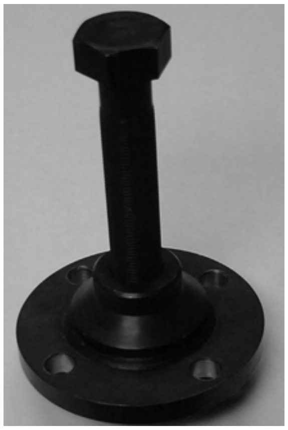


Figure 20

Troubleshooting

The charts that follow contain information to assist in troubleshooting. There may possibly be more than one cause for a machine malfunction.

Refer to the Testing section of this Chapter for precautions and specific test procedures.

General Hydraulic System Problems

Problem	Possible Cause
Hydraulic oil leaks from system.	Fitting(s), hose(s) or tube(s) are loose or damaged. O–ring(s) or seal(s) are missing or damaged.
Hydraulic fluid foams.	Oil level in reservoir is low. Hydraulic system has wrong type of oil. The gear pump suction line has an air leak.
Hydraulic system operates hot.	Oil level in reservoir is low. Oil is contaminated or too light. Parking brake is applied or incorrectly adjusted. Piston pump by–pass valve is open or defective. Charge pressure is low (see Charge Relief Valve Pressure Test in the Testing section of this chapter). Wheel motor(s) is worn or damaged (see Wheel Motor Efficiency Test in the Testing section of this chapter). Piston pump is worn or damaged (see Piston (Traction) Pump Flow Test in the Testing section of this chapter).

Traction Circuit Problems

Problem	Possible Cause
Neutral is difficult to find or unit operates in one direction only.	External traction control linkage is misadjusted, disconnected, binding or damaged. Piston (traction) pump is worn or damaged (see Piston (Traction) Pump Flow Test in the Testing section of this chapter).
Traction response is sluggish.	Hydraulic oil is very cold. Parking brake is applied or incorrectly adjusted. Piston pump by–pass valve is open or defective. Charge pressure is low (see Charge Relief Valve Pressure Test in the Testing section of this chapter). Relief valve(s) in piston (traction) pump are leaking or damaged. Wheel motor(s) is worn or damaged (see Wheel Motor Efficiency Test in the Testing section of this chapter). Piston (traction) pump is worn or damaged (see Piston (Traction) Pump Flow Test in the Testing section of this chapter).
No traction exists in either direction.	Parking brake is applied or incorrectly adjusted. Oil level in reservoir is low (other hydraulic systems also affected). Piston pump by–pass valve is open. Charge pressure is low (see Charge Relief Valve Pressure Test in the Testing section of this chapter). Relief valve(s) in piston (traction) pump are leaking or damaged. Wheel motor(s) is worn or damaged (see Wheel Motor Efficiency Test in the Testing section of this chapter). Piston pump is worn or damaged (see Piston (Traction) Pump Flow Test in the Testing section of this chapter).
Wheel motor will not turn.	Brakes are binding. Key on wheel motor shaft is sheared or missing. Wheel motor is damaged.
Wheel motor will not hold load in neutral.	Make up fluid from charge pump is not available. Piston pump relief valves are damaged.

NOTE: The piston pump used on Greensmaster Tri-Flex machines is equipped with relief valves for both the forward and reverse direction. Due to engine output, it is unlikely that traction pressure will reach relief valve settings. If, however, a piston pump relief valve is leaking or otherwise faulty, traction performance would be affected.

Lift/Lower Circuit Problems

Problem	Possible Cause
Gear pump is noisy (cavitation).	Reservoir oil level is low. Gear pump suction line is restricted. Gear pump suction line has an air leak.
Cutting units will not lift or lift slowly.	Engine speed is too low. Reservoir oil level is low (other hydraulic systems affected as well). Cutting unit suspension components are binding or damaged. Lift cylinder attachment pins are binding. Electrical problem exists that prevents lift control manifold solenoid valve operation (see Chapter 5 – Electrical System). Relief valve in power steering valve is leaking or damaged (see Steering/Lift Relief Valve Pressure Test in the Testing section of this chapter). Solenoid valve (S1) in lift control manifold is leaking or damaged (valve not shifting to its energized position). Lift cylinder(s) leak internally. Spool in power steering valve is sticking (see Power Steering Valve Test in the Testing section of this chapter). Gear pump is worn or damaged (steering and charge circuits affected as well) (see Steering/Lift Circuit Gear Pump Flow Test in the Testing section of this chapter).
Front cutting units (#2 and #3) raise, but will not stay up. (NOTE: Lift cylinders and control manifold check valves cannot provide an absolutely perfect seal. The cutting units will eventually lower if left in the raised position)	Solenoid valve (S3) in lift control manifold is leaking or damaged. Front lift cylinders leak internally.
Center cutting unit (#1) raises, but will not stay up. (NOTE: Lift cylinders and control manifold check valves cannot provide an absolutely perfect seal. The cutting units will eventually lower if left in the raised position)	Solenoid valve (S4) in lift control manifold is leaking or damaged. Center lift cylinder leaks internally.

Steering Circuit Problems

Problem	Possible Cause
Steering wheel is hard to turn.	Power steering valve has insufficient oil flow (lift and charge circuits affected as well) (see Steering/Lift Circuit Gear Pump Flow Test in the Testing section of this chapter). Emergency steering ball in power steering valve is missing or damaged.
Regular adjustments to steering wheel are necessary because of difficulty to drive in a straight line.	Leaf springs in power steering valve are worn or broken. Gear wheel set in power steering valve is worn. Steering cylinder is seized or its piston seals are worn (see Power Steering Valve Test in the Testing section of this chapter).
Steering wheel will not return to the neutral position.	Spool and sleeve are sticking to power steering housing assembly (see Power Steering Valve Test in the Testing section of this chapter).
Steering wheel can turn on its own.	Leaf springs in power steering valve are broken or stuck. Spool and sleeve are sticking to power steering housing assembly (see Power Steering Valve Test in the Testing section of this chapter).
Backlash results when turning steering wheel.	Cardan shaft fork in power steering valve is worn or broken. Leaf springs in power steering valve are worn or broken. Splines on the steering column are worn.
Rear wheel shimmies when the steering wheel is turned.	Air is in the steering cylinder. Rear steering fork assembly is worn or damaged.
The steering wheel can be turned without the rear wheel turning.	The steering cylinder is worn. The gear set in the power steering valve is worn.
Steering response is too slow and heavy when trying to turn quickly.	Gear pump is worn or damaged (lift and charge circuits affected as well) (see Steering/Lift Circuit Gear Pump Flow Test in the Testing section of this chapter).
Turning steering wheel turns machine in the opposite direction.	Hoses to the steering cylinder are reversed. Hoses to the power steering valve are not connected to correct ports.
Steering force (possibly to one side only) is insufficient.	Relief valve in power steering valve is leaking or damaged (see Steering/Lift Relief Valve Pressure Test in the Testing section of this chapter). Gear pump is worn or damaged (lift and charge circuits affected as well) (see Steering/Lift Circuit Gear Pump Flow Test in the Testing section of this chapter).

Testing

The most effective method for isolating problems in the hydraulic system is by using hydraulic test equipment such as pressure gauges and flow meters in the circuits during various operational checks (see the Special Tools section in this Chapter).

IMPORTANT: All obvious areas such as oil supply, filter, binding linkages, loose fasteners, improper adjustments, solenoid valve operation or electrical connections must be checked before assuming that a hydraulic component is the source of the problem.

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved and all rotating machine parts must be stopped. See Relieving Hydraulic System Pressure in the General Information section.

CAUTION

Failure to use gauges with recommended pressure (PSI) rating as listed in test procedures could result in damage to the gauge and possible personal injury from leaking hot oil.

CAUTION

All testing should be performed by two (2) people. One person should be in the seat to operate the machine and the other should monitor testing equipment and record test results.

WARNING

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Do not use hands to search for leaks; use paper or cardboard. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

Precautions for Hydraulic Testing

1. Clean machine thoroughly before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Contamination will cause excessive wear of components.

2. To prevent hydraulic system contamination, put clean metal caps or plugs on any hydraulic lines left open or exposed during testing or removal of components.

3. The engine must be in good operating condition. Engine speed will affect test accuracy. Check pump speed with a phototac when performing hydraulic tests.

4. When using tester with pressure and flow capabilities, the inlet and the outlet hoses must be properly connected and not reversed to prevent damage to the hydraulic tester or other components.

5. When using tester with pressure and flow capabilities, completely open load valve in the hydraulic tester to minimize the possibility of damaging components.

6. Install fittings finger tight and far enough to make sure that they are not cross–threaded before tightening them with a wrench.

7. Position tester hoses to prevent **rotating** machine parts from contacting and damaging the hoses or tester.

8. Check oil level in the hydraulic reservoir. After connecting test equipment, make sure tank is full.

9. Check control linkages for improper adjustment, binding or broken parts.

10. All hydraulic tests should be made with the hydraulic oil at normal operating temperature.

11. Record the results of all performed hydraulic tests.

Which Hydraulic Tests Are Necessary?

Before beginning any hydraulic test, identify if the problem is related to the traction circuit, lift/lower circuit or steering circuit. Once the faulty system has been identified, perform tests that relate to that circuit.

1. Use the Hydraulic Schematic, Hydraulic Flow Diagrams and the Troubleshooting section found in this Chapter to assist in hydraulic problem identification and solution.

2. Hydraulic system problems (e.g. low hydraulic oil level, contaminated oil, incorrect engine speed) will affect the entire hydraulic system.

3. For traction related problems (e.g. machine will not go up an incline), consider performing one or more of the following tests:

A. Charge Relief Valve Pressure.

B. Piston (Traction) Pump Flow.

C. Wheel Motor Efficiency.

NOTE: The piston pump used on Greensmaster Tri-Flex machines is equipped with relief valves for both the forward and reverse direction. Due to engine output, it is unlikely that traction pressure will reach relief valve settings. If, however, a piston pump relief valve is leaking or otherwise faulty, traction performance would be affected.

4. For problems with the steering and lift/lower circuit, consider performing one or more of the following tests:

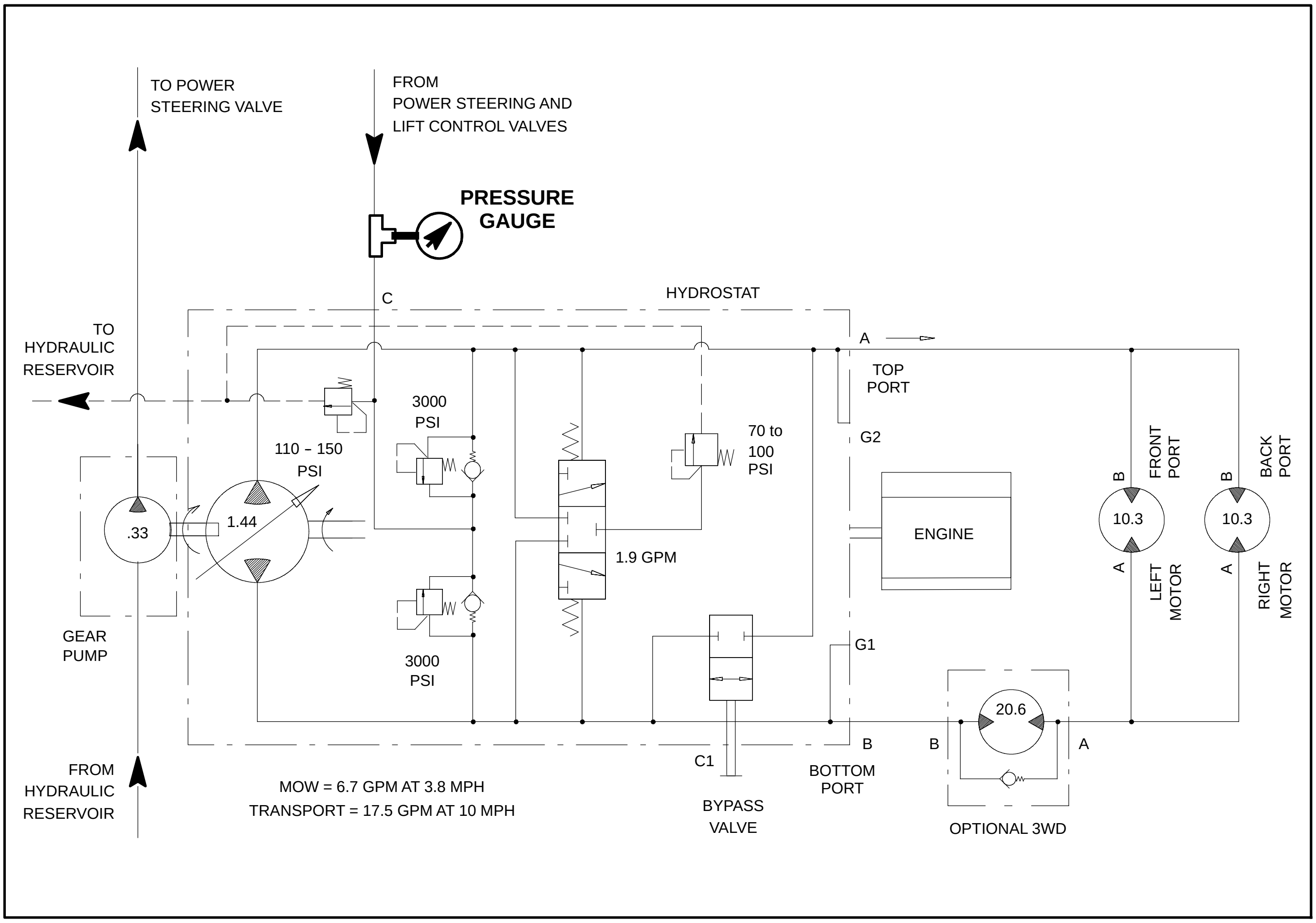
A. Steering/Lift Relief Valve Pressure.

B. Lower Cutting Units Relief Valve (RV) Pressure.

C. Steering/Lift Circuit Gear Pump Flow.

D. Power Steering Valve.

Charge Relief Valve Pressure Test (Using Pressure Gauge)


TO POWER STEERING VALVE
FROM POWER STEERING AND LIFT CONTROL VALVES
PRESSURE GAUGE
C
HYDROSTAT
TO HYDRAULIC RESERVOIR
A
TOP PORT
3000 PSI
110 – 150 PSI
70 to 100 PSI
G2
B
FRONT PORT
B
BACK PORT
.33
1.44
ENGINE
10.3
10.3
1.9 GPM
A
LEFT MOTOR
A
RIGHT MOTOR
GEAR PUMP
3000 PSI
G1
20.6
B
B
A
C1
FROM HYDRAULIC RESERVOIR
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
BOTTOM PORT
BYPASS VALVE
OPTIONAL 3WD

The traction charge circuit is designed to replace loss of hydraulic fluid from the closed loop traction circuit. The charge relief valve pressure test will identify if charge pressure is correct.

Procedure for Charge Relief Valve Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged. Make sure the hydraulic tank is full.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

3. Thoroughly clean junction of hydraulic hose and hydraulic tube that runs under piston (traction) pump. Disconnect hydraulic hose from the hydraulic tube (Fig. 21).

4. Install a tee fitting between the disconnected hose and tube. Install a 1000 PSI (70 bar) pressure gauge to the tee fitting.

5. Make sure that traction pedal, steering wheel and joystick are in the neutral position.

6. Start engine and run at low idle speed. Check for hydraulic leakage at pressure gauge and correct before proceeding with test.

7. Move throttle so engine is running at high idle speed.

8. Pressure gauge should read approximately **110 to 150 PSI (7.6 to 10.3 bar)**.

9. Move throttle to low idle speed and shut off engine. Record test results.

10.If specification is not met, remove piston pump back plate assembly that contains the charge relief valve (see Piston (Traction) Pump Service in the Service and Repairs section of this chapter). Repair or replace relief valve components as necessary.

11. A dynamic charge pressure test can be performed as follows:

A. Position machine so that a load can be placed on the traction system. For example, chain the machine to an immovable object or chock all drive wheels to prevent the machine from moving.

B. With pressure gauge still connected, sit in the operator seat, start the engine and move throttle so engine is running at high idle speed. Move functional control lever to the transport position.

C. While monitoring the pressure gauge, push the traction pedal in the appropriate direction (forward or reverse) to allow traction system load.

D. Once dynamic charge pressure has been determined, move throttle to low idle speed and shut off engine. Record test results.

E. The charge pressure should drop no more than 20% from no–load charge pressure measured in step 9 above (e.g. if charge pressure in step 9 is 125 PSI (8.6 bar), charge pressure in forward or reverse should be more than 100 PSI (6.9 bar).

F. If charge pressure is good under no load, but drops below specification when under traction load, the piston (traction) pump and/or wheel motors should be suspected of wear and inefficiency. When the pump and/or traction motor(s) are worn or damaged, the charge pump is not able to keep up with internal leakage in traction circuit components. Further testing of the traction circuit should be completed (see Piston (Traction) Pump Flow and Wheel Motor Efficiency Tests in this section).

12.When charge pressure testing is complete, disconnect pressure gauge and tee fitting from the hydraulic hose and hydraulic tube. Connect hose to tube.

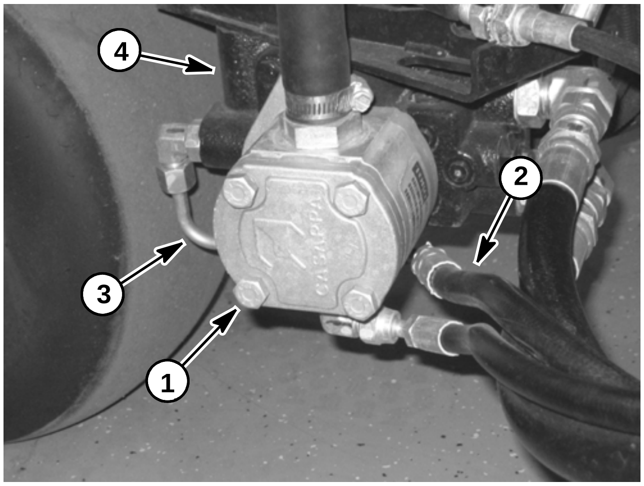
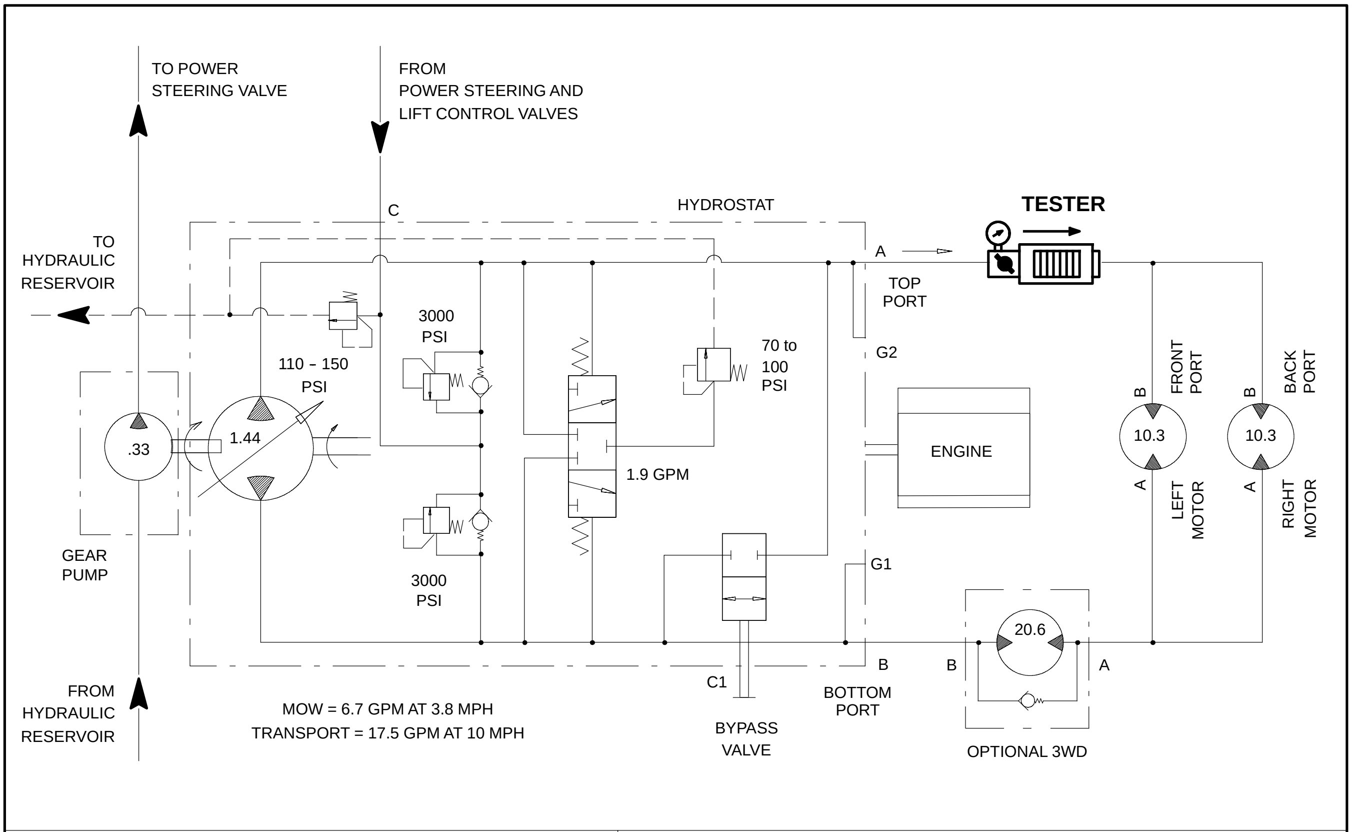


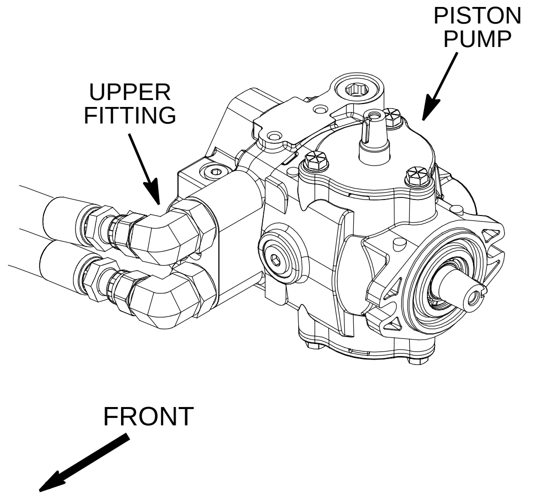
Figure 21

1. Gear pump	**3. Hydraulic tube**
2. Hydraulic hose	**4. Piston (traction) pump**

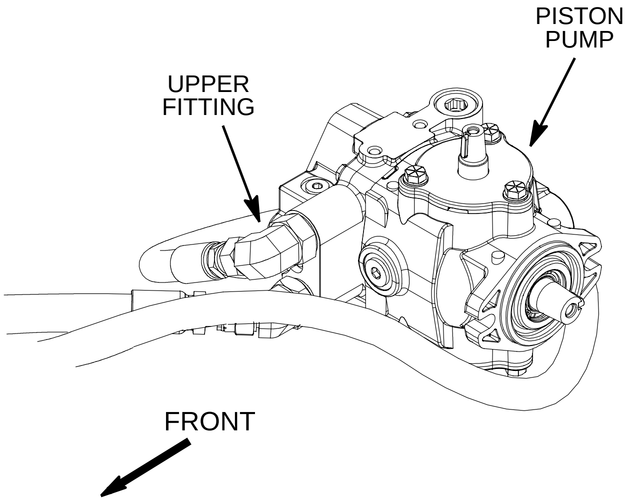
Piston (Traction) Pump Flow Test (Using Tester with Flowmeter and Pressure Gauge)


TO POWER STEERING VALVE
FROM POWER STEERING AND LIFT CONTROL VALVES
C
HYDROSTAT
TESTER
A
TOP PORT
TO HYDRAULIC RESERVOIR
3000 PSI
110 – 150 PSI
70 to 100 PSI
G2
B
FRONT PORT
B
BACK PORT
.33
1.44
ENGINE
10.3
10.3
1.9 GPM
A
LEFT MOTOR
A
RIGHT MOTOR
GEAR PUMP
3000 PSI
G1
20.6
B
B
A
C1
FROM HYDRAULIC RESERVOIR
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
BOTTOM PORT
BYPASS VALVE
OPTIONAL 3WD

PUMP FROM GREENSMASTER 3320


PISTON PUMP
UPPER FITTING
FRONT

PUMP FROM GREENSMASTER 3420


PISTON PUMP
UPPER FITTING
FRONT

This test measures piston pump output (flow). During this test, pump load is created at the flowmeter using the adjustable load valve on the tester.

Procedure for Piston (Traction) Pump Flow Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off. Make sure the hydraulic tank is full.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

3. Make sure the traction pedal is adjusted to the neutral position. Also, make sure that transport speed is properly adjusted.

4. Block up front wheels off the ground (also rear wheel if machine is equipped with 3WD) to allow flow through the traction circuit.

5. Thoroughly clean junction of hydraulic hose and **upper** hydraulic fitting on front side of piston pump (forward port). Disconnect hose from upper pump fitting.

IMPORTANT: Traction circuit flow for Greensmaster TriFlex Hybrid machines is approximately 17 GPM (65 LPM). Use 40 GPM Hydraulic Tester #AT40002 (pressure and flow) for this test (see Special Tools in this chapter).

6. Install 40 GPM Hydraulic Tester #AT40002 (pressure and flow) in series between piston pump fitting and disconnected hose to allow flow from piston pump to tester. Use hydraulic hose kit (see Special Tools in this chapter) to connect tester to machine. Make sure that fitting and hose connections are properly tightened. Also, make sure the flow control valve on tester is fully open.

7. After installing tester, start engine and run at low idle speed. Check for hydraulic leakage and correct before proceeding with test.

8. Move functional lever to the transport position.

CAUTION

Wheels off the ground will be rotating during this test. Make sure machine is properly supported so it will not move and accidentally fall to prevent injuring anyone near the machine.

9. Move throttle so engine is running at high idle speed.

10. Slowly push traction pedal to fully forward position. Keep pedal fully depressed in the forward position.

11. Have second person carefully watch pressure gauge on tester while slowly closing the flow control valve until **1000 PSI (69 bar)** is obtained. Verify with a phototac that the engine speed has not changed.

NOTE: If engine speed drops, piston pump flow will decrease.

12. Observe flow gauge. If piston pump is in good condition, flow indication should be approximately **17.1 GPM (64.7 LPM)**.

13. Release traction pedal, open control valve on tester, move throttle to low idle speed and turn off engine. Record test results.

14. If flow is less than **15.3 GPM (57.9 LPM)**, consider the following:

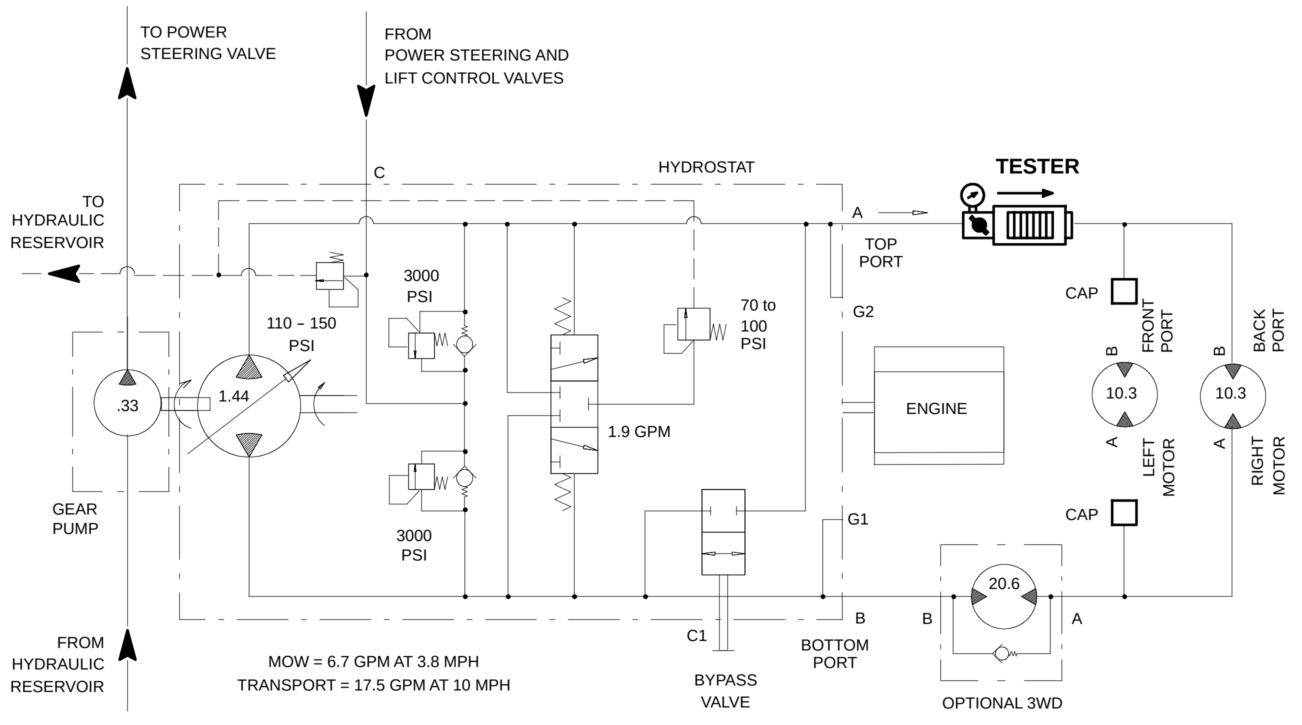
    A. The traction pedal and/or traction speed may need adjustment.

    B. The piston pump needs to be repaired or replaced as necessary.

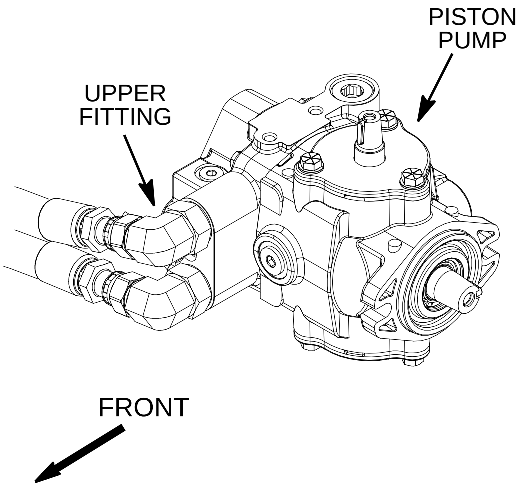
    C. Make necessary repairs before performing additional hydraulic traction circuit tests.

15. When piston pump flow testing is complete, disconnect tester from pump fitting and hose. Connect hydraulic hose to pump fitting.

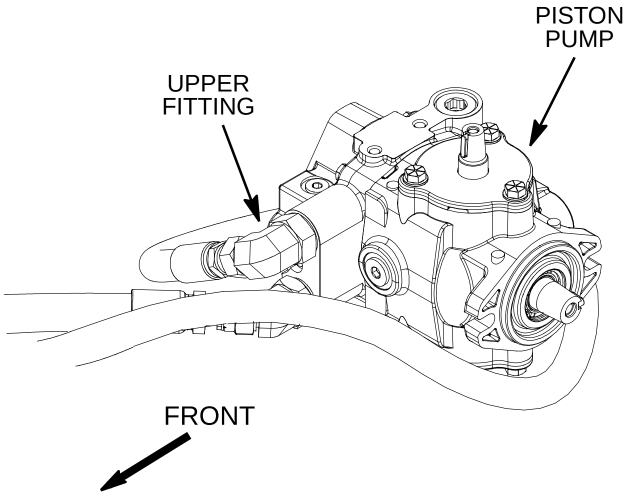
Wheel Motor Efficiency Test (Using Tester with Flowmeter and Pressure Gauge)


TO POWER STEERING VALVE
FROM POWER STEERING AND LIFT CONTROL VALVES
C
HYDROSTAT
TESTER
A
TOP PORT
TO HYDRAULIC RESERVOIR
3000 PSI
110 – 150 PSI
70 to 100 PSI
G2
CAP
FRONT PORT
BACK PORT
B
.33
1.44
ENGINE
10.3
10.3
1.9 GPM
A
LEFT MOTOR
RIGHT MOTOR
GEAR PUMP
3000 PSI
G1
CAP
20.6
B
B
A
C1
FROM HYDRAULIC RESERVOIR
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
BOTTOM PORT
BYPASS VALVE
OPTIONAL 3WD

PUMP FROM GREENSMASTER 3320


PISTON PUMP
UPPER FITTING
FRONT

PUMP FROM GREENSMASTER 3420


PISTON PUMP
UPPER FITTING
FRONT

NOTE: Over a period of time, a wheel motor can wear internally. A worn motor may by–pass oil to its case drain causing the motor to be less efficient. Eventually, enough oil loss will cause the wheel motor to stall under heavy load conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system and affect overall machine performance.

Procedure for Wheel Motor Efficiency Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off. Make sure the hydraulic tank is full.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

3. Read Precautions for Hydraulic Testing in this section.

4. Make sure the traction control assembly is adjusted to the neutral position.

5. Attach a heavy chain to the rear of the machine frame and an immovable object to prevent the machine from moving during testing.

6. If machine has 3 wheel drive (optional kit), block up the rear wheel off the ground to allow flow through the rear wheel motor.

7. Chock front wheel being tested to prevent rotation of the wheel.

8. Thoroughly clean junction of hydraulic lines and fitting on front wheel motor that is **not** being tested. Disconnect hydraulic lines from front wheel motor that is **not** being tested. Cap the disconnected hydraulic lines and fittings in wheel motor.

9. Thoroughly clean junction of hydraulic hose and **upper** hydraulic fitting on front side of piston pump (forward port). Disconnect hose from upper pump fitting.

10. Install hydraulic tester (pressure and flow) in series between piston pump fitting and disconnected hose to allow flow from piston pump to tester (same tester connections as Piston (Traction) Pump Flow Test). Make sure that fitting and hose connections are properly tightened. Also, make sure the flow control valve on tester is fully open.

11. Start engine and run at low idle speed. Check for hydraulic leakage and correct before proceeding with test.

CAUTION

Use extreme caution when performing test. The wheel being tested will be trying to move the machine.

12. Move throttle so engine is running at high idle speed. Make sure that functional control lever is in the transport position.

13. Slowly push traction pedal in **forward** direction until **1000 PSI (69 bar)** is displayed on the tester pressure gauge. Make sure that wheel motor being tested is not rotating.

14. Wheel motor internal leakage will be shown on flow meter. Flow should be **less than 1.5 GPM (5.7 LPM)** for the tested wheel motor.

15. Release traction pedal to the neutral position and release brakes. Rotate wheel being tested and retest. Testing of wheel motor leakage in three (3) different wheel positions will provide most accurate test results.

16. Release traction and brake pedals. Shut engine off. Record results of wheel motor leakage test.

17. If specification is not met, the tested wheel motor needs to be repaired or replaced as necessary.

18. To test second front wheel motor:

   A. Reconnect hydraulic lines to untested front wheel motor.

   B. Disconnect and cap hydraulic lines to tested front wheel motor.

   C. Complete steps 11 to 17 for the second front wheel motor.

19. If machine has 3 wheel drive (optional kit), test rear wheel motor:

   A. Both front wheel motors should have hydraulic lines connected. Block up both front wheels off the ground. Front wheels need to turn freely when testing rear wheel motor.

   B. Attach a heavy chain to the rear of the machine frame and an immovable object to prevent the machine from moving during testing.

   C. Position rear wheel on the ground and chock rear wheel to prevent it from turning.

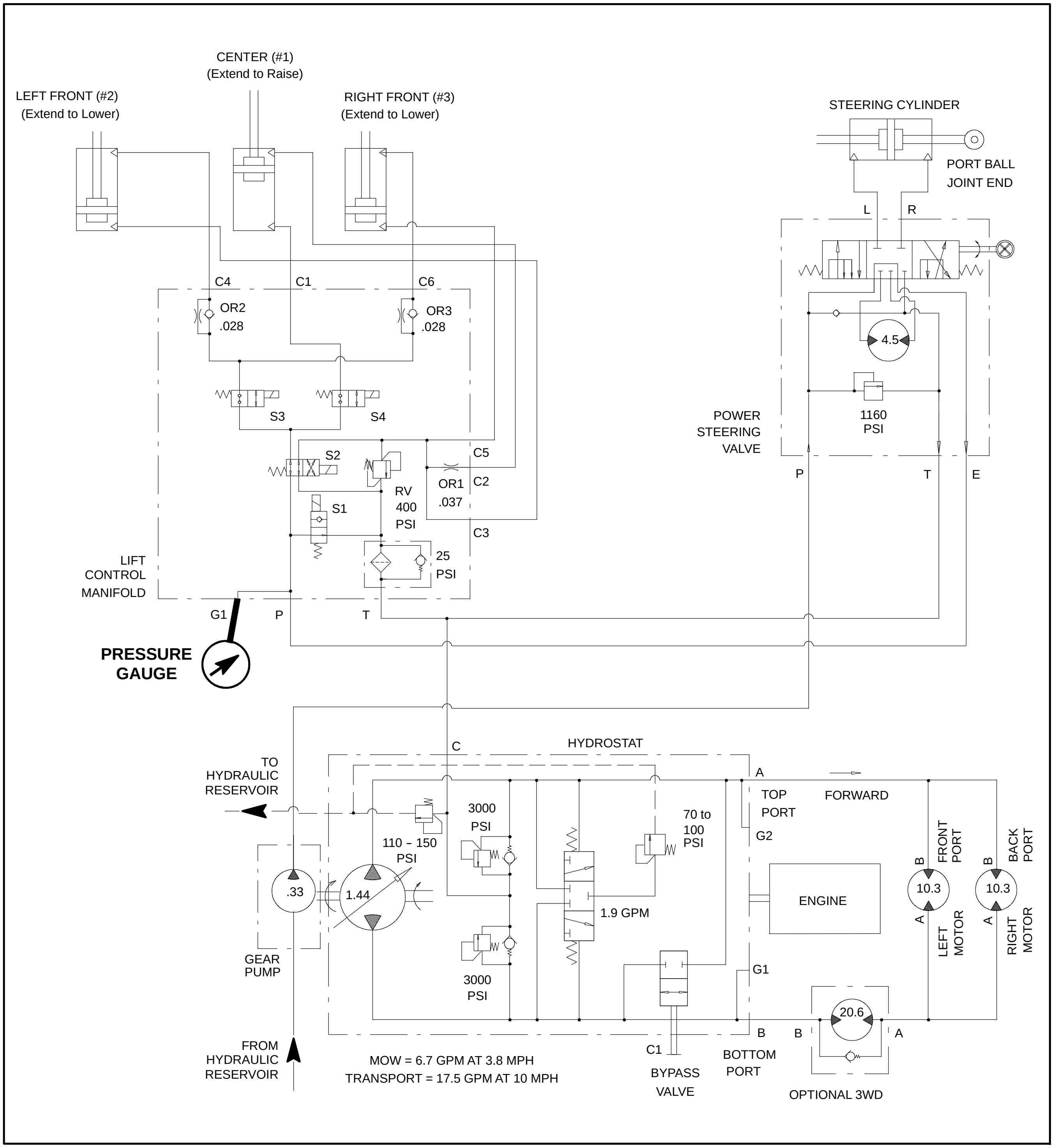
CAUTION

Use extreme caution when performing test. The rear wheel will be trying to move the machine.

   D. Complete steps 11 to 17 to test rear wheel motor leakage.

20. When testing is completed, disconnect tester from hydraulic hose and pump fitting. Connect hose to pump fitting. Make sure that hydraulic connections at wheel motors are all secure.

Steering/Lift Relief Valve Pressure Test (Using Pressure Gauge)


CENTER (#1)
(Extend to Raise)
LEFT FRONT (#2)
(Extend to Lower)
RIGHT FRONT (#3)
(Extend to Lower)
STEERING CYLINDER
PORT BALL
JOINT END
L
R
C4
C1
C6
OR2
.028
OR3
.028
S3
S4
S2
C5
OR1
.037
C2
RV
400
PSI
S1
C3
25
PSI
LIFT
CONTROL
MANIFOLD
G1
P
T
4.5
1160
PSI
POWER
STEERING
VALVE
P
T
E
PRESSURE
GAUGE
C
HYDROSTAT
A
TOP
PORT
FORWARD
G2
TO
HYDRAULIC
RESERVOIR
3000
PSI
110 – 150
PSI
70 to
100
PSI
.33
1.44
1.9 GPM
ENGINE
B
FRONT
PORT
B
BACK
PORT
10.3
10.3
A
LEFT
MOTOR
A
RIGHT
MOTOR
GEAR
PUMP
3000
PSI
G1
20.6
B
B
A
C1
BOTTOM
PORT
BYPASS
VALVE
FROM
HYDRAULIC
RESERVOIR
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
OPTIONAL 3WD

The steering/lift relief valve pressure test should be performed to make sure that the relief pressure for the steering and lift circuits is correct.

Procedure for Steering/Lift Relief Valve Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged. Make sure the hydraulic tank is full.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

NOTE: The steering/lift relief valve is in series with the traction charge relief valve. Traction charge pressure will therefore affect steering/lift relief valve pressure.

3. Measure and record traction charge relief valve pressure (see Charge Relief Valve Pressure Test in this section).

4. Remove right side cover next to operator seat to allow access to lift control manifold.

5. Install 5000 PSI (350 bar) pressure gauge with hydraulic hose attached to lift control manifold test port (G) (Fig. 22).

6. Make sure that traction pedal and joystick are in neutral and the parking brake is engaged.

7. Start engine and run at low idle speed. Check for hydraulic leakage and correct before proceeding with test.

8. Move throttle so engine is running at high idle speed.

CAUTION

While measuring steering/lift relief valve pressure, do not allow circuit pressure to exceed 1400 PSI (82.8 bar).

9. Watch the pressure gauge and move the joystick to the **raise** position. Momentarily hold the joystick with the cutting units fully raised causing the relief valve to open. Release the joystick when the relief pressure is identified.

10. Move throttle to low idle speed and shut off engine. Record pressure at which the relief valve opens.

11. Steering/lift valve pressure should be approximately **1160 PSI (80 bar) higher than the charge relief valve pressure** (e.g. if the charge relief valve pressure is 125 PSI (8.6 bar), the steering/lift relief valve pressure should be approximately 1285 PSI (88.6 bar)).

12. If steering/lift relief valve pressure is incorrect, inspect relief valve located in the power steering valve (see Power Steering Valve Service in the Service and Repairs section of this Chapter). Clean relief valve or service power steering valve as needed.

NOTE: The lower cutting units relief valve (RV) pressure can also be measured with pressure gauge positioned as described in this test (see Lower Cutting Units Relief Valve (RV) Pressure Test in this section).

13. When testing is complete, disconnect pressure gauge from lift control manifold test port. Install dust cap to test port fitting. Install right side cover.

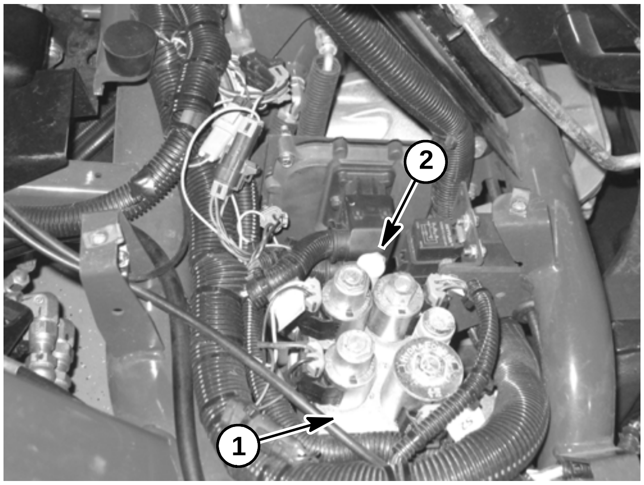
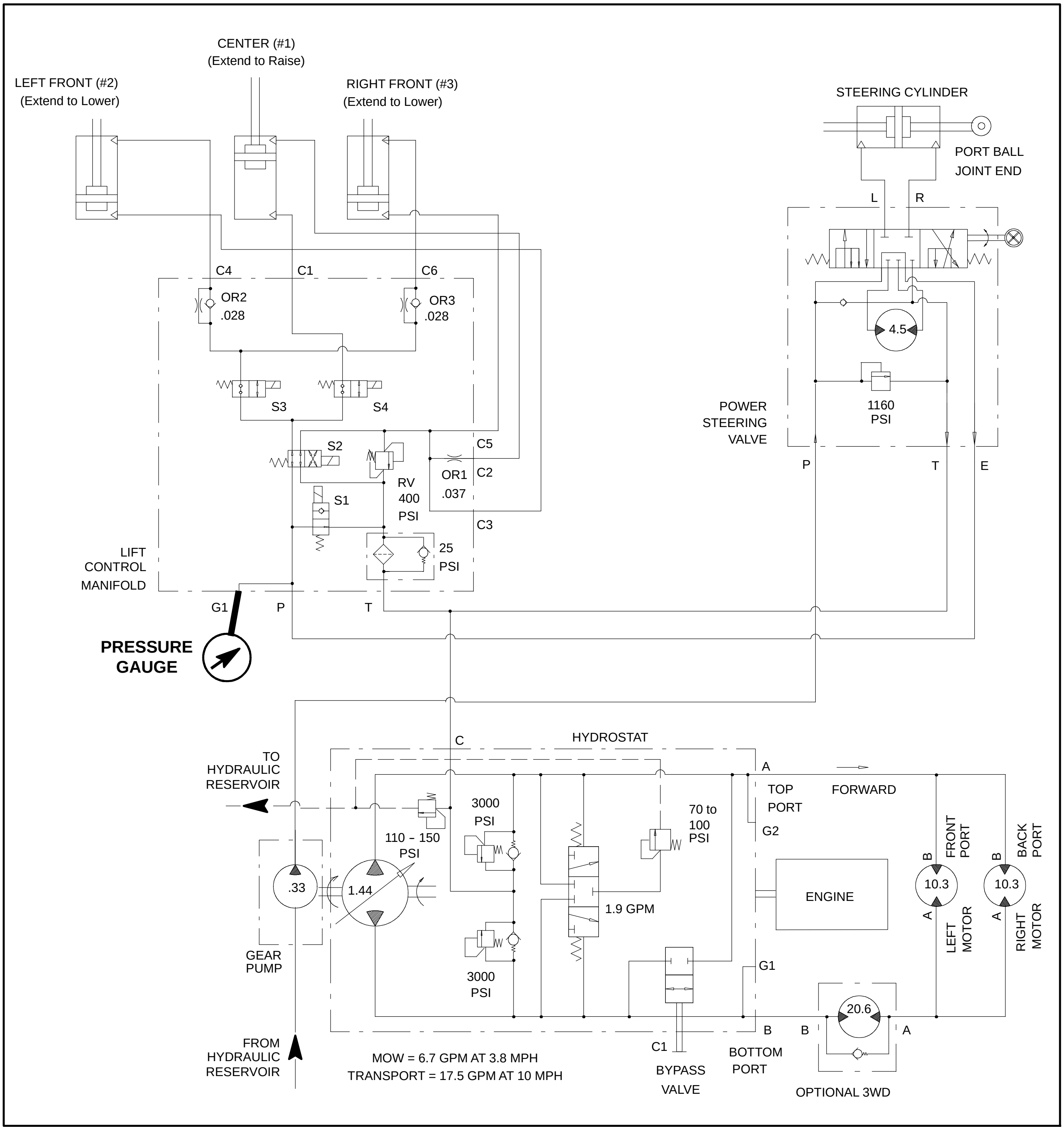


Figure 22

1. **Lift control manifold**
2. **Test port**

Lower Cutting Units Relief Valve (RV) Pressure Test (Using Pressure Gauge)



CENTER (#1)
(Extend to Raise)
LEFT FRONT (#2)
(Extend to Lower)
RIGHT FRONT (#3)
(Extend to Lower)
STEERING CYLINDER
PORT BALL
JOINT END
L
R
C4
C1
C6
OR2
.028
OR3
.028
S3
S4
S2
C5
RV
400
PSI
OR1
.037
C2
S1
C3
25
PSI
LIFT
CONTROL
MANIFOLD
G1
P
T
PRESSURE
GAUGE
4.5
1160
PSI
POWER
STEERING
VALVE
P
T
E
C
HYDROSTAT
TO
HYDRAULIC
RESERVOIR
3000
PSI
110 – 150
PSI
70 to
100
PSI
A
TOP
PORT
FORWARD
G2
.33
1.44
1.9 GPM
ENGINE
FRONT
PORT
BACK
PORT
B
B
10.3
10.3
A
A
LEFT
MOTOR
RIGHT
MOTOR
GEAR
PUMP
3000
PSI
G1
20.6
B
B
A
FROM
HYDRAULIC
RESERVOIR
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
C1
BYPASS
VALVE
BOTTOM
PORT
OPTIONAL 3WD

The lower cutting units relief valve (RV) pressure test should be performed to make sure that the relief pressure for lowering the cutting units is correct.

Procedure for Lower Cutting Units Relief Valve (RV) Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged. Make sure the hydraulic tank is full.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

NOTE: The lower cutting units relief valve is in series with the traction charge relief valve. Charge relief pressure will affect the lower cutting units relief pressure.

3. Measure and record charge relief valve pressure (see Charge Relief Valve Pressure Test in this section).

4. Remove right side cover next to operator seat to allow access to lift control manifold.

5. Install 1000 PSI (70 bar) pressure gauge with hydraulic hose attached to lift control manifold test port (G) (Fig. 23).

6. After installing pressure gauge, start engine and run at low idle speed. Check for hydraulic leakage and correct before proceeding with test.

7. Move throttle so engine is running at high idle speed.

NOTE: The lower cutting units function is electrically timed and automatically turns off after approximately three (3) seconds. While performing this hydraulic test, if relief pressure cannot be determined within the LOWER function three (3) second timeframe, repeat this test procedure.

8. Watch pressure gauge carefully while moving the joystick to LOWER and note pressure that relief valve opens. Release joystick, move throttle to low idle speed and shut off engine. Record test results.

9. The lower cutting units relief pressure should be approximately **400 PSI (27.6 bar) higher than charge relief pressure** (e.g. if charge relief valve pressure is 125 PSI (8.6 bar), the lower relief valve pressure should be approximately 525 PSI (36.2 bar)).

10. If the lower relief valve pressure is incorrect, adjust lower cutting units relief valve on lift control manifold (Fig. 24) (see Adjust Manifold Relief Valves in the Adjustments section of this Chapter). Retest relief valve pressure after adjustment is performed.

NOTE: The steering/lift circuit relief valve pressure can also be measured with pressure gauge positioned as described in this test (see Steering/Lift Relief Valve Pressure Test in this section).

11. When testing is complete, disconnect pressure gauge from lift control manifold test port. Install dust cap to test port fitting. Install right side cover.

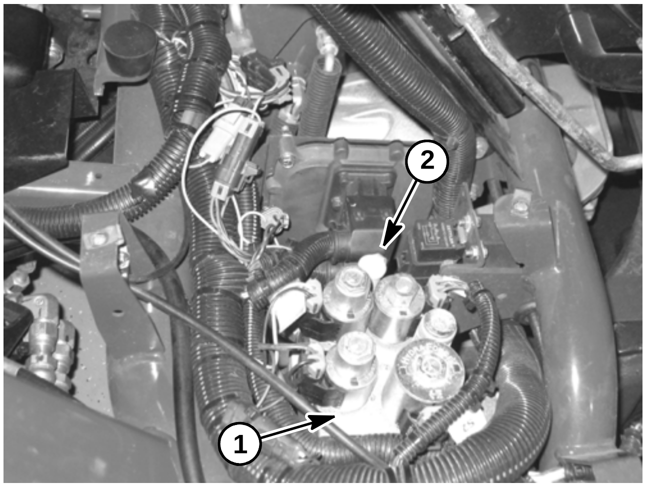


Figure 23

1. **Lift control manifold**
2. **Test port**

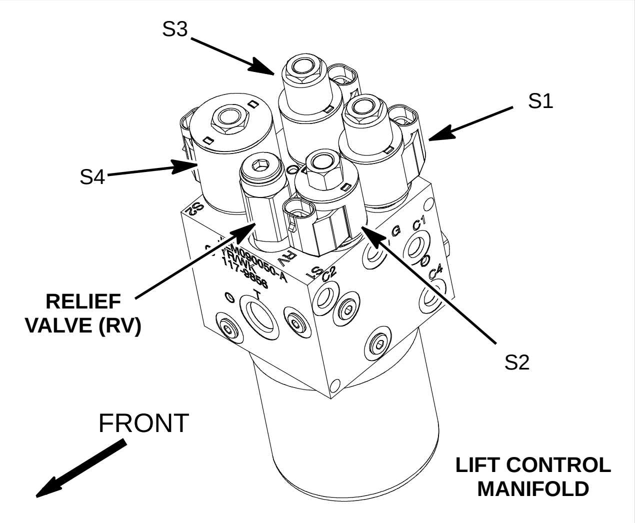
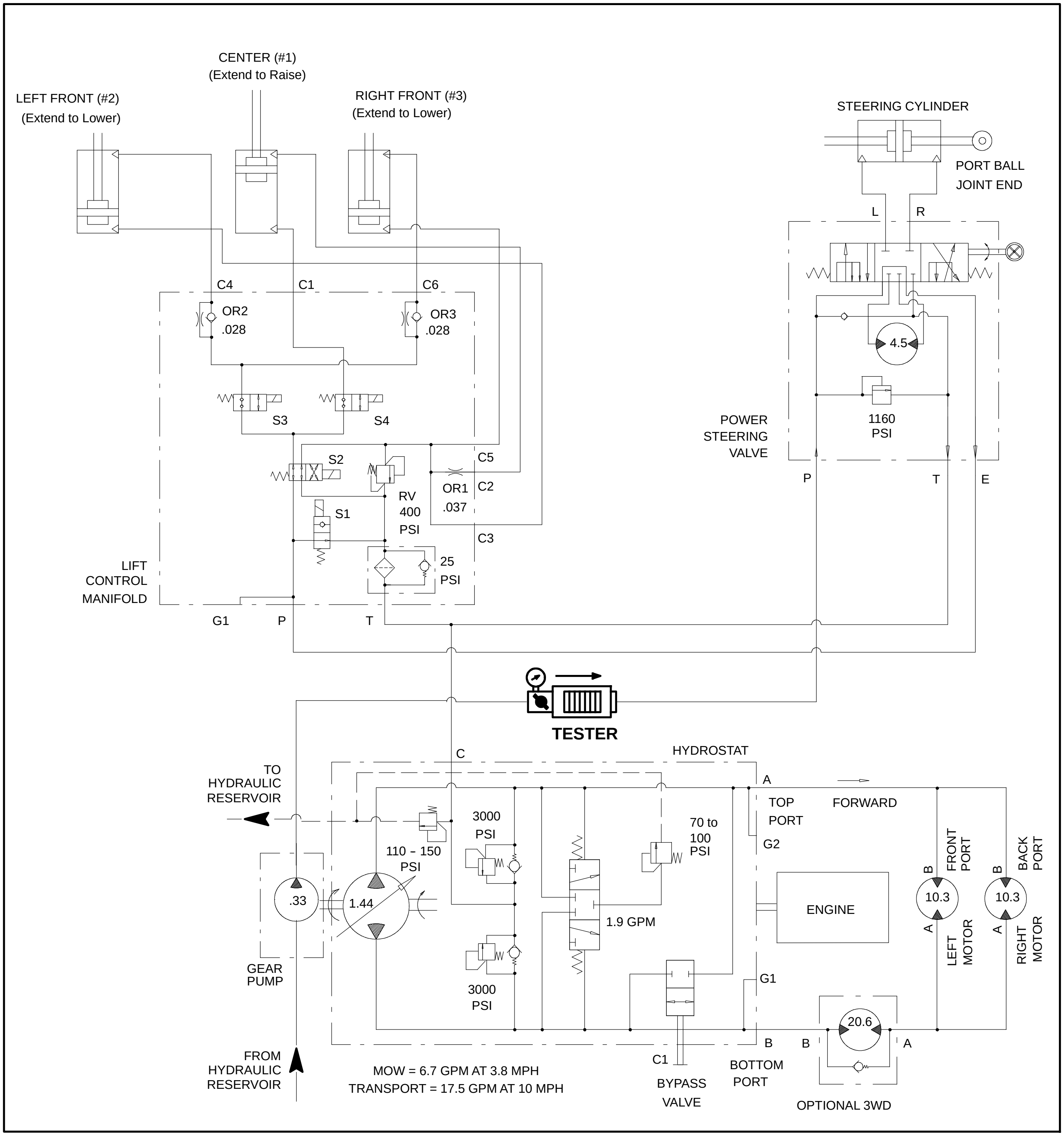


Figure 24

Steering/Lift Circuit Gear Pump Flow Test (Using Tester with Flowmeter and Pressure Gauge)


CENTER (#1)
(Extend to Raise)
LEFT FRONT (#2)
(Extend to Lower)
RIGHT FRONT (#3)
(Extend to Lower)
STEERING CYLINDER
PORT BALL
JOINT END
L
R
C4
C1
C6
OR2
.028
OR3
.028
S3
S4
S2
C5
C2
RV
400
PSI
OR1
.037
S1
C3
25
PSI
LIFT
CONTROL
MANIFOLD
G1
P
T
4.5
1160
PSI
POWER
STEERING
VALVE
P
T
E
TESTER
C
HYDROSTAT
TO
HYDRAULIC
RESERVOIR
A
TOP
PORT
FORWARD
3000
PSI
70 to
100
PSI
G2
110 – 150
PSI
FRONT
PORT
BACK
PORT
B
B
.33
1.44
ENGINE
10.3
10.3
1.9 GPM
A
A
LEFT
MOTOR
RIGHT
MOTOR
GEAR
PUMP
G1
3000
PSI
20.6
B
B
A
C1
FROM
HYDRAULIC
RESERVOIR
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
BOTTOM
PORT
BYPASS
VALVE
OPTIONAL 3WD

The steering/lift circuit gear pump flow test should be performed to make sure that the steering, lift and traction charge circuits have adequate hydraulic flow.

Procedure for Steering/Lift Circuit Gear Pump Flow Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.

2. Park machine on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged. Make sure the hydraulic tank is full.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

3. Thoroughly clean junction of hydraulic hose and discharge (lower) fitting of gear pump (Fig. 25). Disconnect hose from pump fitting.

4. Install hydraulic tester (pressure and flow) in series with the gear pump fitting and the disconnected hose. Make sure that tester flow arrow points from the pump discharge and toward the disconnected hose. **Also, make sure flow control valve on the tester is fully open.**

5. Make sure that traction pedal and joystick are in neutral and the parking brake is engaged.

6. Start engine and run at low idle speed. Check for hydraulic leakage and correct before proceeding with test.

7. Move throttle so engine is running at high idle speed.

IMPORTANT: Do not fully restrict oil flow through tester. In this test, the flow tester is positioned before the circuit relief valve. Pump damage can occur if the oil flow is fully restricted.

8. Watch flow and pressure gauge carefully while slowly closing the flow control valve on the tester until the pressure gauge reads **800 PSI (55.2 bar)**.

9. Open control valve on tester, move throttle to low idle speed and shut off engine. Record test results.

10. Flow gauge reading for a gear pump in good condition should be approximately **3.6 GPM (13.6 LPM)**.

11. If gear pump flow is less than **3.1 GPM (11.7 LPM)**, check for restriction in the pump intake line. If no restriction is found, repair or replace gear pump.

12. When testing is complete, disconnect tester from the gear pump fitting and hydraulic hose. Connect hose to pump fitting.

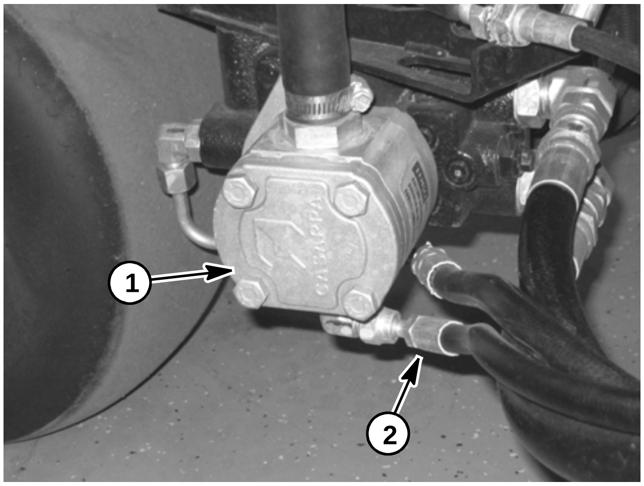
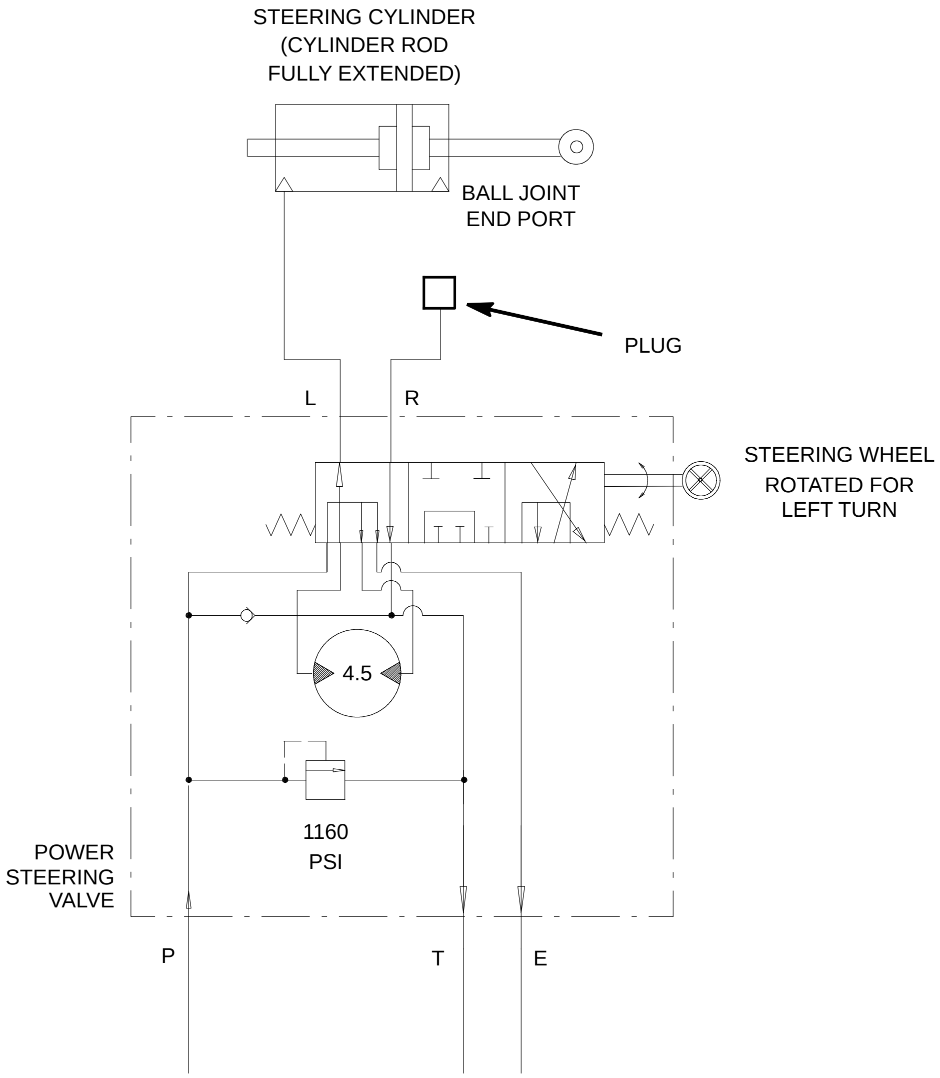


Figure 25

1. **Gear pump**
2. **Hydraulic hose**


STEERING CYLINDER
(CYLINDER ROD
FULLY EXTENDED)
BALL JOINT
END PORT
PLUG
L
R
STEERING WHEEL
ROTATED FOR
LEFT TURN
4.5
1160
PSI
POWER
STEERING
VALVE
P
T
E

NOTE: This steering test procedure will be affected by incorrect rear tire pressure, binding in the hydraulic steering cylinder, extra weight on the vehicle and/or binding of the steering fork assembly. Make sure that these items are checked before proceeding with any hydraulic testing procedure.

Procedure for Power Steering Valve Test:

1. Make sure the hydraulic tank is full.

2. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.

3. Perform the Steering/Lift Relief Valve Pressure and Steering/Lift Circuit Gear Pump Flow Tests to make sure that relief valve and gear pump are functioning correctly (see Steering/Lift Relief Valve Pressure and Steering/Lift Circuit Gear Pump Flow Tests in this section).

4. Drive machine slowly in a figure eight on a flat level surface.

   A. There should be no shaking or vibration in the steering wheel or rear wheel.

   B. Steering wheel movements should be followed **immediately** by a corresponding rear wheel movement **without** the steering wheel continuing to turn.

5. Stop the unit with the engine running. Turn steering wheel with small quick movements in both directions. Let go of the steering wheel after each movement.

   A. The steering wheel must go back immediately to the neutral position.

   B. The steering wheel should **not** continue to turn.

NOTE: The steering wheel must be able to turn with no more than **45 in-lb (5.1 N-m)** of torque.

6. If either of these performance tests indicate a steering problem, determine if the steering cylinder is faulty using the following procedure.

   A. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

   B. Turn the steering wheel all the way to the left (counterclockwise) so the steering cylinder rod is fully extended.

   C. Turn engine off.

CAUTION

Prevent personal injury and/or damage to equipment. Read all WARNINGS, CAUTIONS and Precautions for Hydraulic Testing at the beginning of this section.

   D. Read Precautions for Hydraulic Testing.

   E. Remove hydraulic hose from the fitting on the ball joint end of the steering cylinder (Fig. 26). Plug the end of the hose.

   F. With the engine off, continue turning the steering wheel to the left (counterclockwise) with the steering cylinder fully extended. Observe the open fitting on the steering cylinder as the steering wheel is turned. If oil comes out of the fitting while turning the steering wheel to the left, the steering cylinder has internal leakage and must be repaired or replaced.

   G. When steering cylinder testing is completed, remove plug from the hydraulic hose. Connect hose to the steering cylinder fitting.

7. If steering problem exists and steering cylinder tested acceptably, power steering valve requires service (see Power Steering Valve and Power Steering Valve Service in the Service and Repairs section of this chapter).

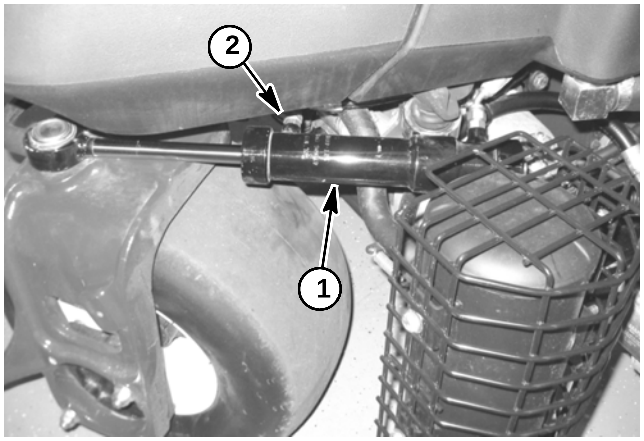


Figure 26

1. Steering cylinder **2. Ball joint end hose**

Adjust Manifold Relief Valves

The lift control manifold includes an adjustable relief valve. If adjustment of this valve is necessary, follow the following procedure.

NOTE: Do not remove relief valve from the hydraulic manifold for adjustment.

WARNING

Never adjust the relief valve with the hydraulic system pressurized. Hydraulic oil may spray out of the valve when the cap is off. Personal injury may result. Always install and tighten the cap before pressurizing the system.

1. Locate relief valve on control manifold.

2. Remove cap on relief valve with an allen wrench.

3. To **increase** pressure setting, turn the adjustment socket on the valve in a clockwise direction. A 1/8 turn on the socket will make a measurable change in relief pressure.

4. To **decrease** pressure setting, turn the adjustment socket on the valve in a counterclockwise direction. A 1/8 turn on the socket will make a measurable change in relief pressure.

5. Install and tighten cap on relief valve.

6. Recheck relief pressure and readjust as needed.

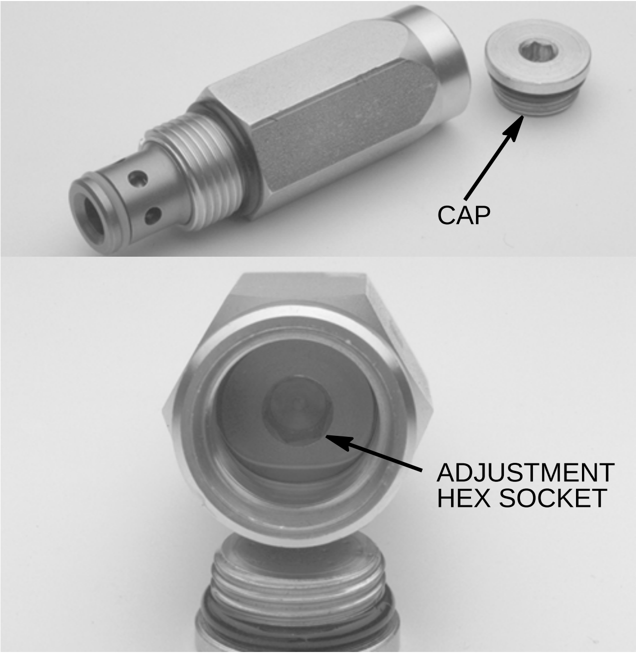


Figure 27

Adjust Traction Control Assembly

Proper control of the traction circuit is accomplished by the traction pedal, cables and piston (traction) pump neutral assembly. Adjustments to these components may be required for correct operation. Use the following information and the illustrations in the right column when adjusting the traction control on your Greensmaster.

With the functional lever placed in the transport position, the traction pedal should bottom against pedal stop on platform in the full forward direction when piston pump is at full stroke. If pump reaches full stroke before pedal contacts stop, traction cable can experience premature wear.

When functional lever is placed in the neutral position with the traction pedal locked in place, the pedal should be at a right angle (90º) to platform (Fig. 29). If necessary, adjust location of ball joint on neutral lock cable to allow correct angle of pedal.

In the neutral position, there should be no tension on the traction cable. If cable is adjusted too tight, machine could creep when in the neutral position. Adjust jam nuts on traction cable to reduce tension on cable.

An eccentric on the piston pump neutral assembly can be adjusted to eliminate machine creep when in the neutral position (Fig. 30). Adjustments to traction pedal, traction cable and neutral lock cable should be checked before adjusting the eccentric. Eccentric adjustment should be done with engine running and the traction pedal locked in the neutral position.

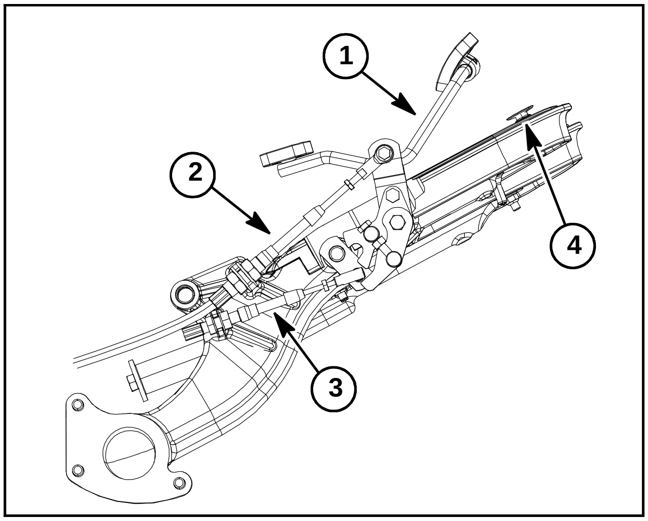


Figure 28

1. **Traction pedal**
2. **Traction cable**
3. **Neutral lock cable**
4. **Pedal stop**

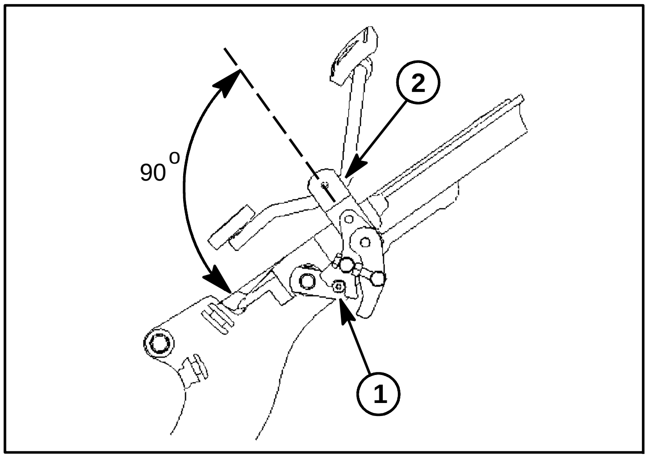


Figure 29

1. **Neutral lock shaft**
2. **Traction pedal**

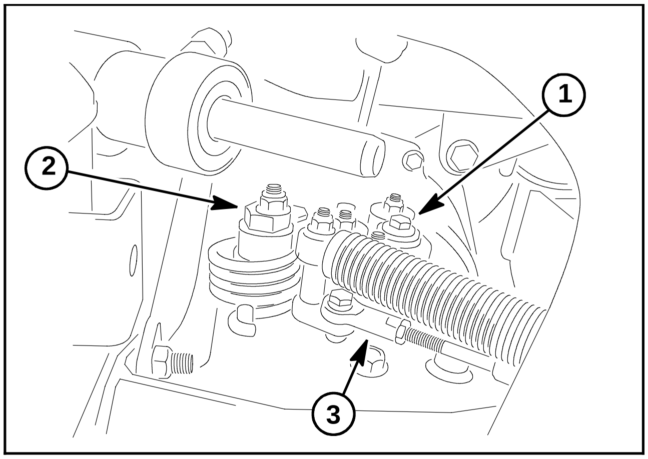


Figure 30

1. **Pump neutral assembly**
2. **Eccentric**
3. **Traction cable**

Service and Repairs

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Components

1. Before removing any parts from the hydraulic system, park machine on a level surface, disengage and lower cutting units, move functional control lever to neutral (N), engage parking brake and stop the engine. Remove the key from the ignition switch. Wait for all machine movement to stop before getting off machine.

2. Clean machine before disconnecting, removing or disassembling any hydraulic components. Make sure hydraulic components, hose connections and fittings are cleaned thoroughly. Always keep in mind the need for cleanliness when working on hydraulic equipment.

CAUTION

Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.

3. Put clean caps or plugs on any hydraulic lines, hydraulic fittings and components left open or exposed to prevent contamination.

4. Put labels on disconnected hydraulic tubes and hoses for proper installation after repairs are completed.

5. Note the position of hydraulic fittings (especially elbow fittings) on hydraulic components before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hydraulic hoses and tubes.

After Repair or Replacement of Components

1. Check oil level in the hydraulic reservoir and add correct oil if necessary. Drain and refill hydraulic system reservoir and change oil filter if component failure was severe or system is contaminated (see Flush Hydraulic System in this section).

2. Lubricate O–rings and seals with clean hydraulic oil before installing hydraulic components.

3. Make sure caps or plugs are removed from the hydraulic lines, hydraulic fittings and components before reconnecting hydraulic lines.

4. Use proper tightening methods when installing hydraulic fittings and lines (see Hydraulic Fitting Installation and Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. After repairs, check control linkages or cables for proper adjustment, binding or broken parts.

6. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system (see Charge Hydraulic System in this section).

7. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in hydraulic reservoir and add correct oil if necessary.

Flush Hydraulic System

IMPORTANT: Flush the hydraulic system any time there is a severe component failure or the system is contaminated (oil appears milky or black or contains metal particles).

IMPORTANT: Flush hydraulic system when changIng from petroleum base hydraulic fluid. Operate machine under normal operating conditions for at least four (4) hours before draining.

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

2. Clean area around gear pump suction (inlet) hose (Fig. 31). Clamp pump inlet hose. Remove inlet hose from gear pump, release clamp and drain reservoir into a suitable container. Drain entire hydraulic system while making sure lift cylinders, hydraulic hoses, hydraulic tubes and all other components are drained from low points while the system is warm.

3. Clean oil filter mounting area. Remove filter and drain into a suitable container. Discard filter.

4. Inspect and clean reservoir (see Hydraulic Reservoir in this section).

5. Make sure filter mounting surface is clean. Apply clean hydraulic oil to gasket on the new filter. Screw filter on until gasket contacts mounting plate, then tighten filter an additional 3/4 turn.

NOTE: Use only hydraulic fluids (including biodegradable fluid) specified in the Traction Unit Operator's Manual. Other fluids could cause system damage.

6. Connect all hydraulic hoses and lines that were disconnected prior to system draining (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Fill hydraulic reservoir with new hydraulic oil.

8. Disconnect appropriate electrical component(s) to prevent the engine from starting:

   A. On machines with gasoline engine, disconnect both spark plug wires from spark plugs.

   B. On machines with diesel engine, disconnect wire harness electrical connector from the engine fuel stop solenoid.

9. Turn ignition key switch and engage starter for ten (10) seconds to the prime pump. Return ignition switch to off and wait one (1) minute to allow starter to cool. Repeat step a second time.

10. Reconnect engine electrical component(s) that were disabled in step 8 above.

11. Start engine and let it run at low idle speed for a minimum of two (2) minutes. Increase engine speed to high idle for a minimum of one (1) minute under no load.

12. Raise and lower cutting units several times.

13. Shut off engine and check for hydraulic oil leaks. Check oil level in hydraulic reservoir and add correct oil if necessary.

14. Operate the machine for two (2) hours under normal operating conditions.

15. Check condition of hydraulic oil. If the new fluid shows any signs of contamination or if you are changing to biodegradable fluid, repeat steps 1 through 14 again.

16. Assume normal operation and follow recommended maintenance intervals.

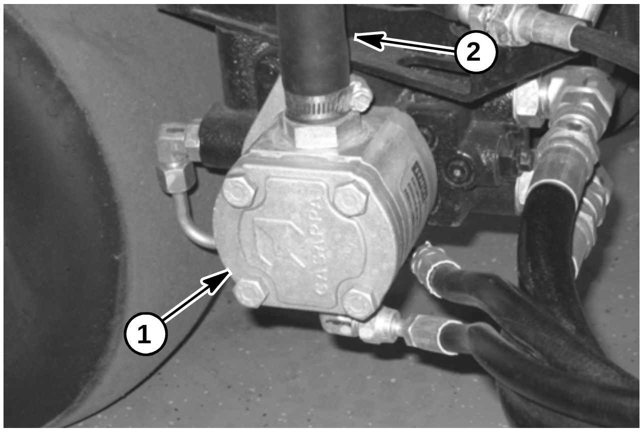


Figure 31

1. **Gear pump**
2. **Suction (inlet) hose**

Filtering Closed–Loop Traction Circuit

Filtering of a closed–loop hydraulic system after a major component failure (e.g. traction (piston) pump or wheel motor) is a requirement to prevent debris from transmitting throughout the system. If a closed–loop hydraulic system filtering tool is not used to ensure system cleanliness, repeat failures, as well as subsequent damage to other hydraulic components in the affected system, will occur. To effectively remove contamination from closed–loop traction circuit, use of the Toro high flow hydraulic filter and hydraulic hose kits are recommended (see Special Tools in this chapter).

1. Park machine on a level surface with engine stopped and key removed from ignition switch.

2. Raise and support machine so all wheels are off the ground (see Jacking Instructions in Chapter 1 – Safety).

NOTE: If wheel motor was replaced, install high flow filter to the inlet of new motor instead of to piston (traction) pump fitting. This will prevent system contamination from entering and damaging the new motor.

3. Thoroughly clean junction of hydraulic hose and **lower** fitting on side of piston pump (Fig. 32). Disconnect hose from lower pump fitting.

4. Connect Toro high flow hydraulic filter in series between piston pump fitting and disconnected hose. Use hydraulic hose kit (see Special Tools in this chapter) to connect filter to machine. Make sure that fitting and hose connections are properly tightened.

IMPORTANT: Use only hydraulic fluids specified in Traction Unit Operator's Manual. Other fluids could cause system damage.

5. After installing high flow filter to machine, check and fill hydraulic reservoir with new hydraulic oil as required.

6. Start engine and run at idle speed. Check for any hydraulic leakage from filter and hose connections. Correct any leaks before proceeding.

CAUTION

All wheels will be off the ground and rotating during this procedure. Make sure machine is well supported so it will not move and accidentally fall to prevent injuring anyone around machine.

IMPORTANT: While engaging the traction circuit, monitor the indicator on the high flow hydraulic filter. If the indicator should show red, either reduce pressure on the traction pedal or reduce engine speed to decrease hydraulic flow through the filter.

7. With engine running at low idle speed, move functional control lever to the transport position and slowly move the traction pedal to the forward direction. This will allow flow through the traction circuit and high flow filter. Keep traction circuit engaged for five (5) minutes while gradually increasing both forward pressure on traction pedal and engine speed. Monitor filter indicator to make sure that green color is showing during operation.

8. With engine running at high idle speed and traction pedal moved to the forward direction, periodically apply brakes to increase pressure in traction circuit. While monitoring filter indicator, continue this process for an additional five (5) minutes.

IMPORTANT: If using a filter that is not the bi–directional Toro high flow filter, do not press the traction pedal in the reverse direction. If flow is reversed when using a filter that is not bi–directional, debris from the filter will re–enter the traction circuit.

9. With engine running at high idle speed, alternately move traction pedal from forward to reverse. While monitoring filter indicator, continue this process for an additional five (5) minutes.

10. Shut engine off and remove key from ignition switch.

11. Remove high flow hydraulic filter and hydraulic hose kit from machine. Connect hydraulic hose to lower piston (traction) pump fitting. Make sure to properly tighten hose (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

12. Lower machine to ground.

13. Check oil level in hydraulic reservoir and add correct oil if necessary.

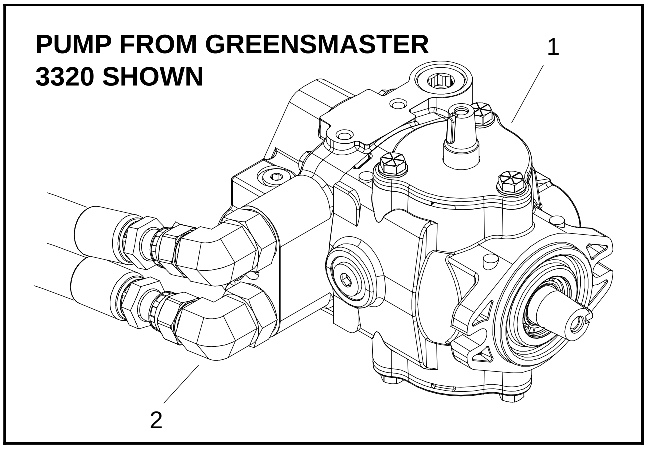


Figure 32

1. Piston (traction) pump
2. Lower fitting

Hydraulic System Start-up

NOTE: When initially starting the hydraulic system with new or rebuilt components such as wheel motors, pumps or lift cylinders, it is important that this start-up procedure be used. This procedure reduces the chance of damaging the hydraulic system or its components from not purging the system of air.

1. After the hydraulic system components have been properly installed and if the piston pump was rebuilt or replaced, make sure piston pump housing is at least half full of clean hydraulic oil.

2. Make sure all hydraulic connections and lines are secured tightly.

3. Make sure hydraulic reservoir is full. Add correct oil if necessary. Drain, flush and refill hydraulic system reservoir and change oil filter if component failure was severe or system is contaminated.

4. After repairs, check control linkage for proper adjustment, binding or broken parts.

5. Disconnect cutting units from the electrical power supply by separating the cutting unit power disconnect couplers on the left side of the operator seat (Fig. 33). This will prevent unexpected cutting unit operation during hydraulic system start-up.

6. Make sure functional control lever is in the **neutral** position.

7. Disconnect appropriate electrical component(s) to prevent the engine from starting:

    A. On machines with gasoline engine, disconnect both spark plug wires from spark plugs.

    B. On machines with diesel engine, disconnect wire harness electrical connector from the engine fuel stop solenoid.

8. Turn ignition key switch and engage starter for ten (10) seconds to prime hydraulic pumps. Return ignition switch to off and wait one (1) minute to allow starter to cool. Repeat step a second time.

9. Reconnect engine electrical component(s) that were disabled in step 7 above.

10. Make sure functional control lever is in the **neutral** position. Start engine and run at low idle speed. The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in thirty (30) seconds, stop the engine and determine the cause.

11. After the hydraulic system starts to show signs of fill, accomplish the following:

    A. If the gear pump was replaced or rebuilt, run the engine at low idle speed setting (under no load) for ten (10) minutes.

    B. If the piston pump or a wheel motor was replaced or rebuilt, move functional control lever to the transport position and run the traction unit so the wheels turn slowly for ten (10) minutes.

12. Operate the machine (traction, steering and lift circuits) by gradually increasing the work load to full over a ten (10) minute period.

13. Stop the machine. Check hydraulic reservoir and fill if necessary. Check hydraulic components for leaks and tighten any loose connections.

14. Connect the cutting unit power disconnect couplers on the left side of the operator seat (Fig. 33).

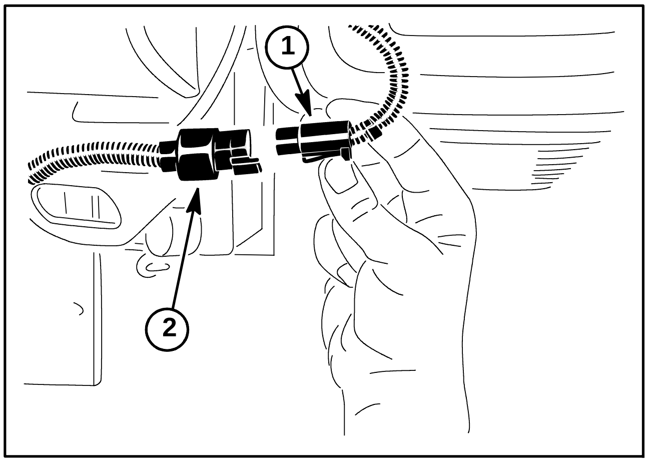


Figure 33

1. **Coupler**
2. **Stationary coupler**

Gear Pump

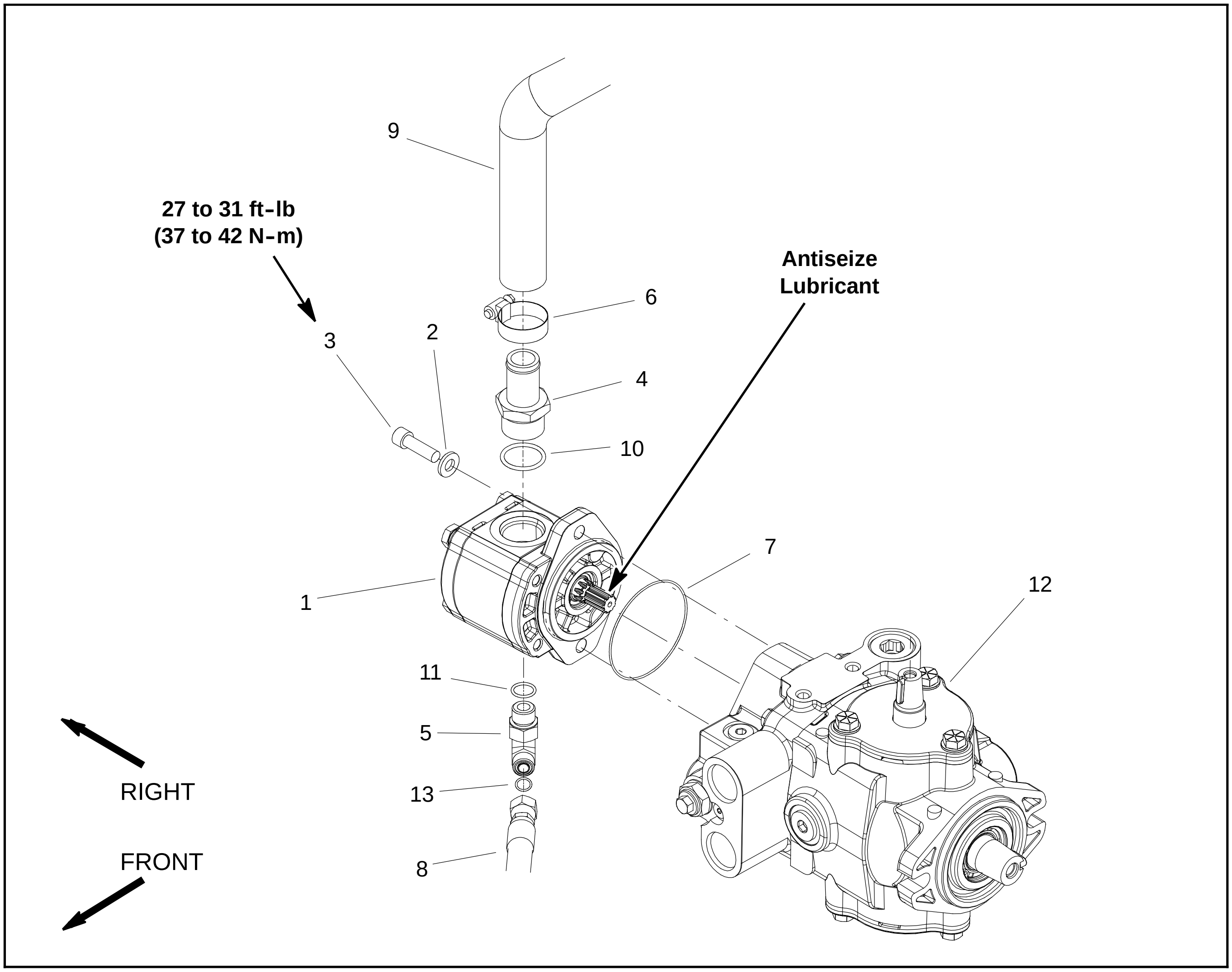


Figure 34

1. **Gear pump**
2. **Flat washer (2 used)**
3. **Socket head screw (2 used)**
4. **Hydraulic fitting**
5. **90^{o} hydraulic fitting**
6. **Hose clamp**
7. **O-ring**
8. **Hydraulic hose (steering/lift supply)**
9. **Suction (inlet) hose**
10. **O-ring**
11. **O-ring**
12. **Piston (traction) pump**
13. **O-ring**

Removal (Fig. 34)

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. Thoroughly clean hydraulic hose ends and fittings on gear pump to prevent hydraulic system contamination.

3. Label all hose connections on gear pump for assembly purposes.

4. Clamp gear pump suction (inlet) hose to prevent draining the hydraulic tank.

5. Loosen hose clamp and remove suction hose from the gear pump.

6. Disconnect hydraulic hose from fitting on bottom of the gear pump. Allow hose to drain into a suitable container. Plug hose to prevent contamination.

IMPORTANT: Note position of hydraulic fitting on bottom of pump for assembly purposes.

7. Mark hydraulic fitting orientation on bottom of pump to allow correct assembly. Remove hydraulic fittings and O–rings from gear pump. Discard removed O–rings.

8. Support gear pump to prevent it from falling. Separate gear pump from the piston pump by removing two (2) socket head screws and flat washers.

9. Remove O–ring (item 7) from between the gear pump and piston pump. Discard O–ring.

10. Inspect threads and sealing surfaces of fittings and gear pump ports. Replace components if damage is found.

Installation (Fig. 34)

1. Make sure mounting and O–ring sealing surfaces on the gear pump and piston pump are clean.

2. Apply clean hydraulic oil to gear pump flange O–ring (item 7). Place O–ring on the gear pump.

3. Apply antiseize lubricant to gear pump shaft splines.

IMPORTANT: Position gear pump to the piston (traction) pump so that the gear pump inlet (suction) port is facing up.

4. Position gear pump to the piston (traction) pump so that the pump inlet is facing up.

5. Secure gear pump to the piston pump with two (2) socket head screws and flat washers. Torque screws from **27 to 31 ft–lb (37 to 42 N–m)**.

6. Lubricate and place new O–rings onto gear pump hydraulic fittings. Install fittings into pump openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

7. Remove all plugs that were placed during disassembly from hydraulic hoses.

8. Lubricate new O–ring and connect hydraulic hose to lower gear pump fitting. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

9. Install suction hose to the gear pump inlet fitting and secure with hose clamp.

10. Remove clamp from pump suction (inlet) hose to allow hydraulic oil flow to the gear pump.

11. Check oil level in hydraulic reservoir and add correct oil if necessary.

12. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

Gear Pump Service

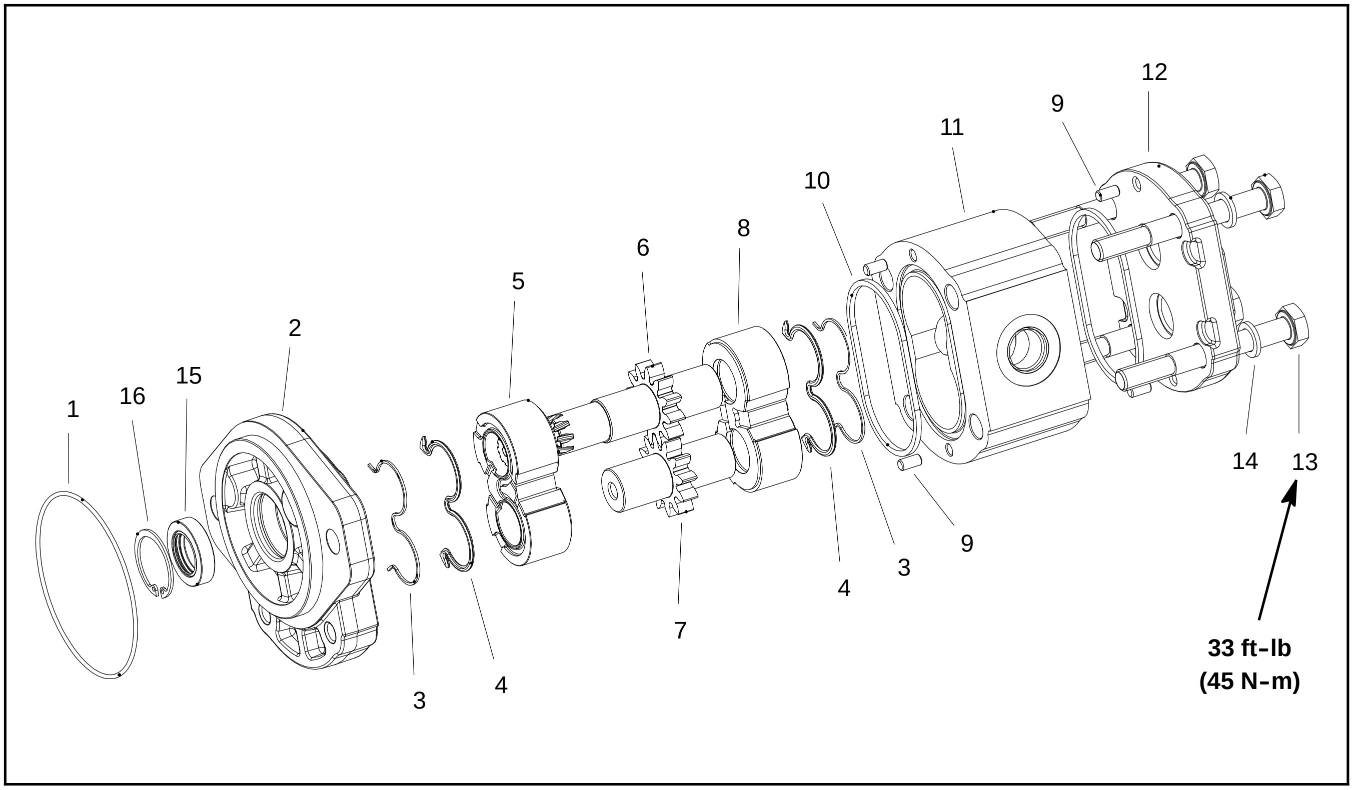


Figure 35

1. **O–ring**
2. **Front cover**
3. **Back–up seal**
4. **Pressure seal**
5. **Front thrust plate**
6. **Drive shaft**
7. **Idler gear**
8. **Rear thrust plate**
9. **Dowel pin (4 used)**
10. **O–ring**
11. **Housing**
12. **End cover**
13. **Cap screw (4 used)**
14. **Washer (4 used)**
15. **Shaft seal**
16. **Retaining ring**

Gear Pump Disassembly (Fig. 35)

NOTE: Disassemble gear pump for cleaning, inspection and seal replacement only. Individual gears, housings and thrust plates are not available separately. If internal components are worn or damaged, the gear pump must be replaced as a complete assembly.

1. Plug pump ports and thoroughly clean exterior of pump with cleaning solvent. Make sure work area is clean.

2. Use a marker to make diagonal line across the front cover, housing and end cover for assembly purposes (Fig. 36).

IMPORTANT: Use caution when clamping gear pump in a vise to avoid distorting any pump components. Also, use a vise with soft jaws.

3. Secure the front cover of the pump in a vise with soft jaws with the drive shaft pointing down.

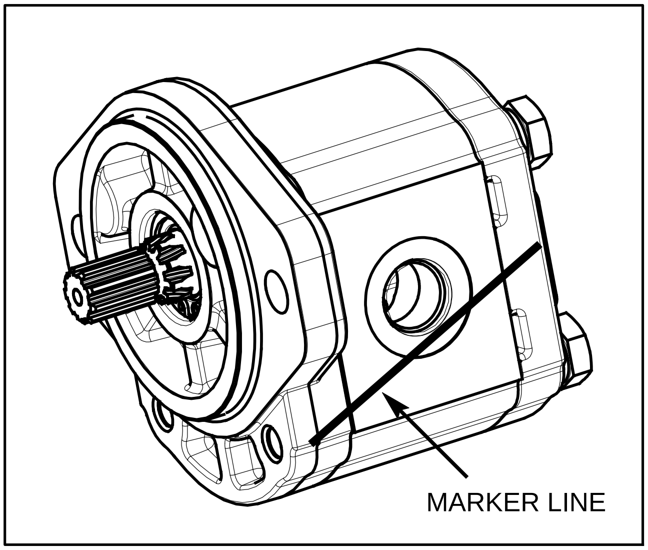


Figure 36

4. Loosen the four (4) cap screws that secure pump assembly.

5. Remove pump from vise and remove fasteners.

6. Support the pump assembly and gently tap the pump housing with a soft face hammer to loosen the pump section. Be careful to not drop parts or disengage gear mesh.

IMPORTANT: Mark the relative positions of the gear teeth and the thrust plates so they can be assembled in the same position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.

7. Remove the thrust plates and seals from pump. Before removing gear set, apply marking dye to mating teeth to retain ”timing”. Pump efficiency may be affected if the teeth are not installed in the same position during assembly.

8. Turn front cover over, with seal side up.

IMPORTANT: Make sure to not damage the front cover counter bore when removing the seal from the cover.

9. Carefully remove retaining ring and shaft seal from the front cover (Fig. 37). Discard removed seal.

10. Clean all parts. Check all components for burrs, scoring, nicks or other damage.

11. Replace the entire pump assembly if any internal pump components are excessively worn, scored or damaged.

Gear Pump Assembly (Fig. 35)

NOTE: When assembling the gear pump, check the marker line on front cover, housing and end cover to make sure the parts are properly aligned during assembly.

1. Apply clean hydraulic oil to all pump parts before assembling.

2. Install new seal into front cover (Fig. 37):

   A. Press shaft seal into front cover until it reaches the bottom of the bore. Shaft seal should have the seal lip and spring toward the inside of the pump.

   B. Install retaining ring into the groove of the front cover. Make sure that retaining ring is fully seated in front cover groove.

NOTE: Pressure and back–up seals fit in grooves machined into thrust plates. Body O–rings fit in grooves machined in housing.

3. Assemble pump components starting at front cover end. Apply grease or petroleum jelly to new section seals to hold them in position during gear pump assembly.

4. After pump has been assembled, tighten four (4) cap screws by hand. Rotate the drive shaft to check for binding. Protect the shaft if using a pliers to rotate shaft.

5. Torque the cap screws evenly in a crossing pattern to **33 ft–lb (45 N–m)**.

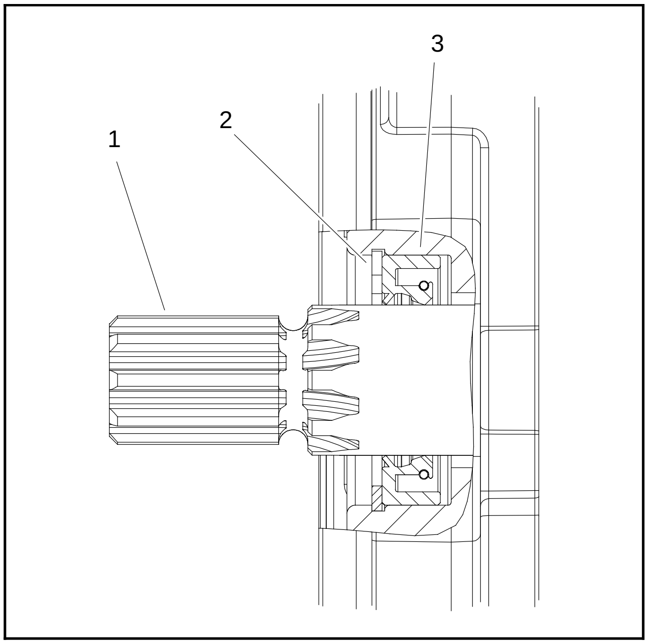


Figure 37

1. **Drive shaft**
2. **Retaining ring**
3. **Shaft seal**

Piston (Traction) Pump Neutral Assembly

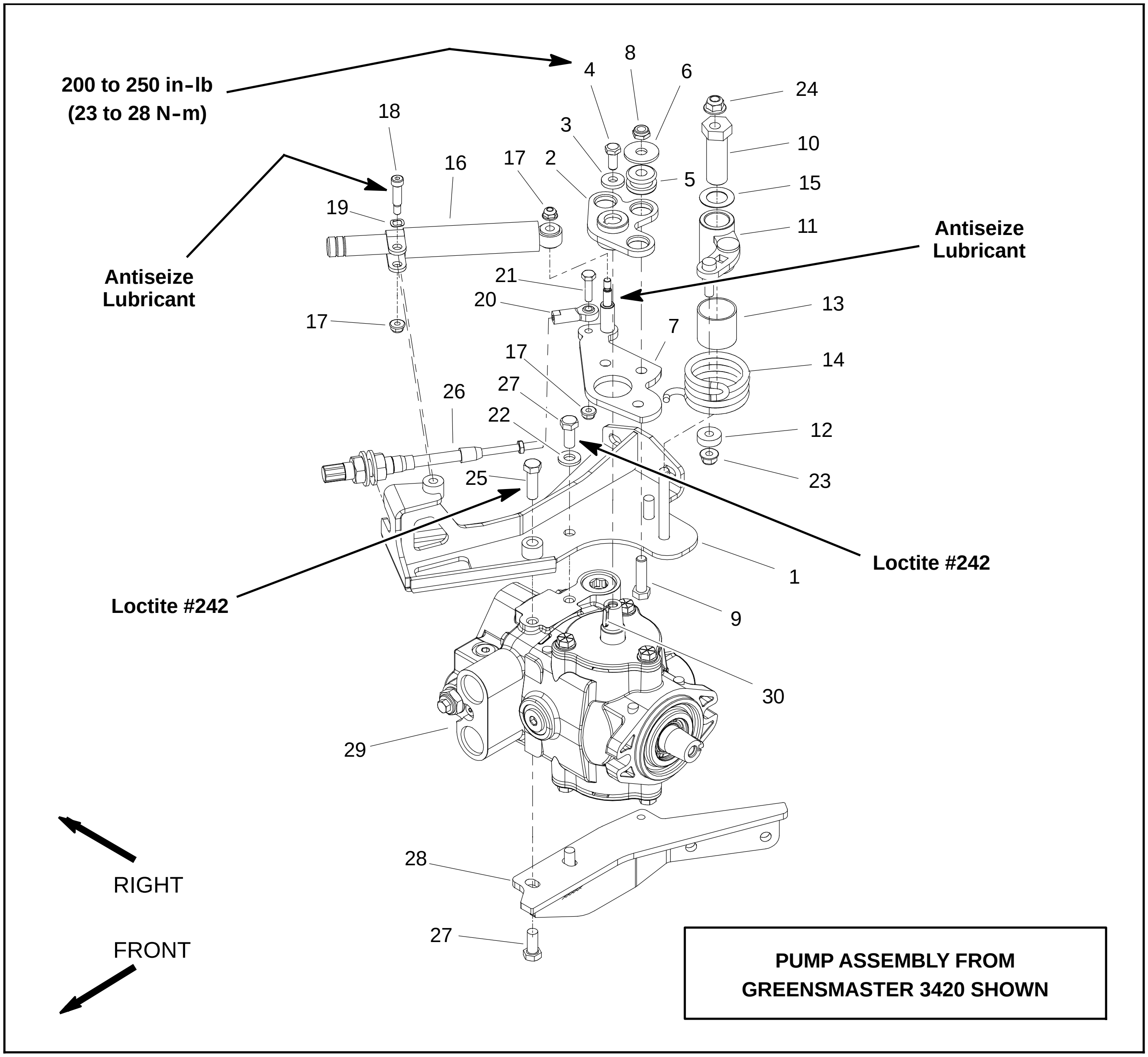

200 to 250 in-lb
(23 to 28 N-m)
8
4
6
24
18
3
10
16
17
2
5
15
19
11
Antiseize Lubricant
Antiseize Lubricant
21
20
13
17
7
17
14
27
26
22
12
25
23
Loctite #242
1
Loctite #242
9
30
29
RIGHT
28
FRONT
27
PUMP ASSEMBLY FROM
GREENSMASTER 3420 SHOWN

Figure 38

1. **Cable support (diesel shown)**
2. **Plate**
3. **Flat washer**
4. **Cap screw**
5. **Mount (3 used)**
6. **Washer (3 used)**
7. **Pump lever**
8. **Lock nut (3 used)**
9. **Cap screw (3 used)**
10. **Eccentric stud**
11. **Neutral arm**
12. **Ball bearing**
13. **Spring spacer**
14. **Torsion spring**
15. **Nylon washer**
16. **Damper lever**
17. **Flange nut (3 used)**
18. **Shoulder bolt**
19. **Wave washer**
20. **Cable end ball joint**
21. **Cap screw**
22. **Washer**
23. **Flange nut**
24. **Flange nut**
25. **Cap screw**
26. **Traction control cable**
27. **Cap screw (2 used) (diesel)**
28. **Muffler bracket (diesel)**
29. **Piston (traction) pump**
30. **Key**

NOTE: The piston pump neutral assembly used on all Greensmaster TriFlex Hybrid machines are very similar. The pump assembly from the Greensmaster 3420 machine is shown in Figure 38.

Disassembly (Fig. 38)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

CAUTION

The torsion spring (item 14) is under tension and may cause personal injury during removal. Use caution when removing the spring from the pump neutral assembly.

2. Remove components from traction neutral assembly as needed using Figure 38 as a guide.

Assembly (Fig. 38)

1. Install removed components to traction neutral assembly using Figure 38 as a guide along with the following:

CAUTION

The torsion spring (item 14) is under tension and may cause personal injury during installation. Use caution when installing the spring to the pump neutral assembly.

A. If cable support (item 1) was removed from pump, apply Loctite #242 (or equivalent) to threads of screws that secure support to pump.

B. If plate (item 2) was removed from pump trunnion shaft, make sure that both trunnion shaft and plate bore are thoroughly cleaned before installing plate to shaft. Secure plate to trunnion shaft with flat washer (item 3) and cap screw (item 4). Torque cap screw from **200 to 250 in-lb (23 to 28 N-m)**.

C. If damper lever (item 16) was removed, apply antiseize lubricant to post on pump lever (7) and shoulder of bolt (item 18) during assembly.

D. Make sure that ball bearing (item 12) on neutral arm (item 11) is properly positioned in pump lever (item 7) after assembly.

2. After traction neutral assembly has been installed, make sure that the transmission is adjusted for the neutral position so that the machine does not move or creep when the traction pedal is in neutral.

Piston (Traction) Pump

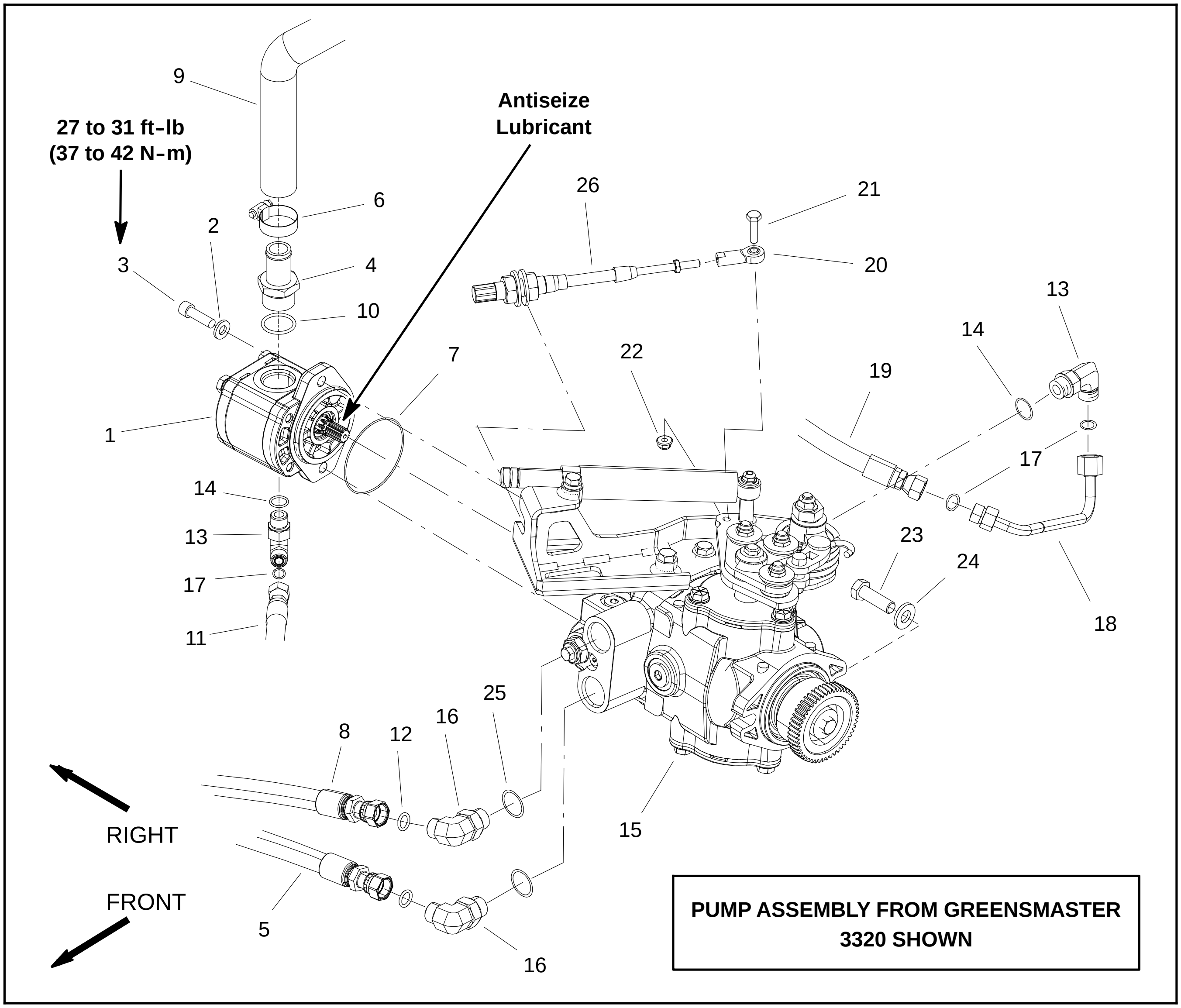

9
27 to 31 ft-lb
(37 to 42 N-m)
Antiseize
Lubricant
26
21
6
2
3
4
20
13
10
14
7
22
19
1
17
14
13
23
24
17
18
11
25
8
12
16
RIGHT
15
FRONT
5
PUMP ASSEMBLY FROM GREENSMASTER 3320 SHOWN
16

Figure 39

1. **Gear pump**
2. **Hardened washer (2 used)**
3. **Socket head screw (2 used)**
4. **Hydraulic fitting**
5. **Hydraulic hose (traction reverse)**
6. **Hose clamp**
7. **O-ring**
8. **Hydraulic hose (traction forward)**
9. **Suction (inlet) hose**
10. **O-ring**
11. **Hydraulic hose (steering/lift supply)**
12. **O-ring**
13. **90° hydraulic fitting**
14. **O-ring**
15. **Piston (traction) pump**
16. **90° hydraulic fitting (2 used)**
17. **O-ring**
18. **Hydraulic tube**
19. **Hydraulic hose (charge supply)**
20. **Ball joint**
21. **Cap screw**
22. **Flange nut**
23. **Cap screw (2 used)**
24. **Flat washer (2 used)**
25. **O-ring**
26. **Traction control cable**

NOTE: The piston (traction) and gear pump assembly can be removed from the machine with the neutral assembly attached to the piston pump. See Piston (Traction) Pump Neutral Assembly in this section for information regarding servicing the neutral assembly.

NOTE: The piston pump assembly used on all Greensmaster TriFlex Hybrid machines are very similar. The pump assembly from the Greensmaster 3320 machine is shown in Figure 39.

Piston Pump Removal (Fig. 39)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

2. Disconnect the traction control cable ball joint (item 20) from the pump lever. Loosen traction control cable jam nuts that secure traction control cable to the cable support. Position cable away from the pump assembly.

3. Thoroughly clean hydraulic hose ends and fittings on gear and piston (traction) pumps to prevent hydraulic system contamination.

4. Label all hydraulic hose connections on gear and piston pumps for assembly purposes.

5. Clamp pump suction hose (item 9) to prevent draining the hydraulic reservoir.

6. Loosen hose clamp and remove suction hose from the gear pump.

7. Disconnect remaining hydraulic hoses from fittings on gear and piston pump assembly. Allow hoses to drain into a suitable container. Plug hoses and fittings to prevent contamination.

CAUTION

Support the gear and piston pump assembly when removing its supporting fasteners to prevent it from falling and causing damage or personal injury.

8. Support pump assembly to prevent it from falling.

9. Remove two (2) cap screws (item 23) and flat washers (item 24) that secure pump assembly to pump mount. Slide pump assembly away from the pump mount and coupling attached to engine. Remove pump from machine.

10. If necessary, remove coupling from pump shaft (Greensmaster 3320 machines shown in Figure 40 or Greensmaster 3420 shown in Figure 41). Locate and retrieve key from pump shaft.

11. Remove gear pump from the piston pump (see Gear Pump Removal in this section).

IMPORTANT: If fittings are to be removed from piston pump, note position of fittings for assembly purposes.

12. If fitting removal from piston pump is necessary, mark hydraulic fitting orientation to allow correct assembly. Remove hydraulic fittings and O–rings from piston pump. Discard removed O–rings.

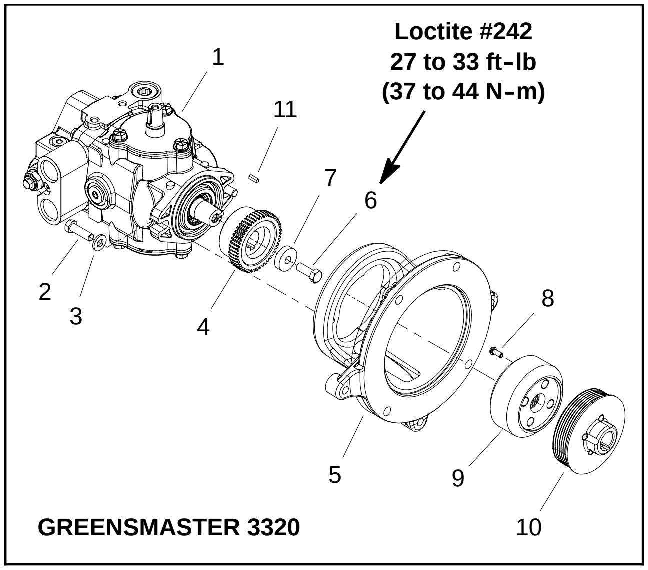


Figure 40

1. **Piston pump**
2. **Cap screw (2 used)**
3. **Flat washer (2 used)**
4. **Coupling**
5. **Pump mount**
6. **Cap screw**
7. **Spacer**
8. **Screw (4 used)**
9. **Coupling**
10. **Generator drive pulley**
11. **Key**

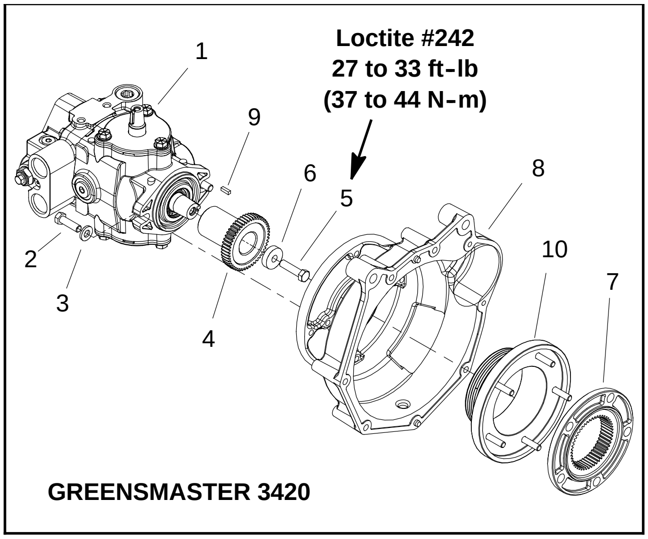


Figure 41

1. **Piston pump**
2. **Cap screw (2 used)**
3. **Flat washer (2 used)**
4. **Coupling**
5. **Cap screw**
6. **Spacer**
7. **Engine coupling flange**
8. **Bell housing**
9. **Key**
10. **Generator drive pulley**

Piston Pump Installation (Fig. 39)

1. Make sure the flange surfaces of the gear pump and piston pump are thoroughly clean.

2. Install gear pump to the piston pump (see Gear Pump Installation in this section).

3. If removed, secure pump coupling to piston pump shaft (Fig. 40 or 41):

    A. Make sure that pump shaft and bore of coupling are thoroughly cleaned.

    B. Position key to pump shaft.

    C. Apply Loctite #242 (or equivalent) to the threads of the cap screw used to secure coupling to pump shaft.

    D. Slide coupling onto pump shaft and secure with spacer and cap screw. Torque cap screw from **27 to 33 ft–lb (37 to 44 N–m)**.

4. Inspect threads and sealing surfaces of hydraulic fittings and hydraulic hose connectors. Replace any damaged or worn fittings or connectors.

5. Lubricate and place new O–rings onto all removed hydraulic fittings. Install fittings into pump openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

6. Insert coupling on pump shaft into coupling attached to engine and slide pump assembly to pump mount. Secure pump assembly to pump mount with two (2) cap screws (item 23) and flat washers (item 24).

7. Remove plugs that were placed during disassembly from hydraulic fittings and hoses.

8. Using labels placed during pump removal, lubricate new O–rings and connect hydraulic hoses to gear pump and piston pump fittings. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

9. Connect the traction control cable to the neutral arm:

    A. Secure cable ball joint to neutral arm with cap screw (item 21) and flange nut (item 22).

    B. Secure control cable to neutral arm with cable jam nuts. Make sure that a lock washer is positioned on each side of the neutral arm.

10. Remove clamp from gear pump suction hose (item 9).

11. Check oil level in hydraulic reservoir and add correct oil if necessary.

12. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

13. Check neutral position of the traction pedal. If adjustment is required, see Adjust Transmission for Neutral in the Traction Unit Owners Manual.

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Piston (Traction) Pump Service

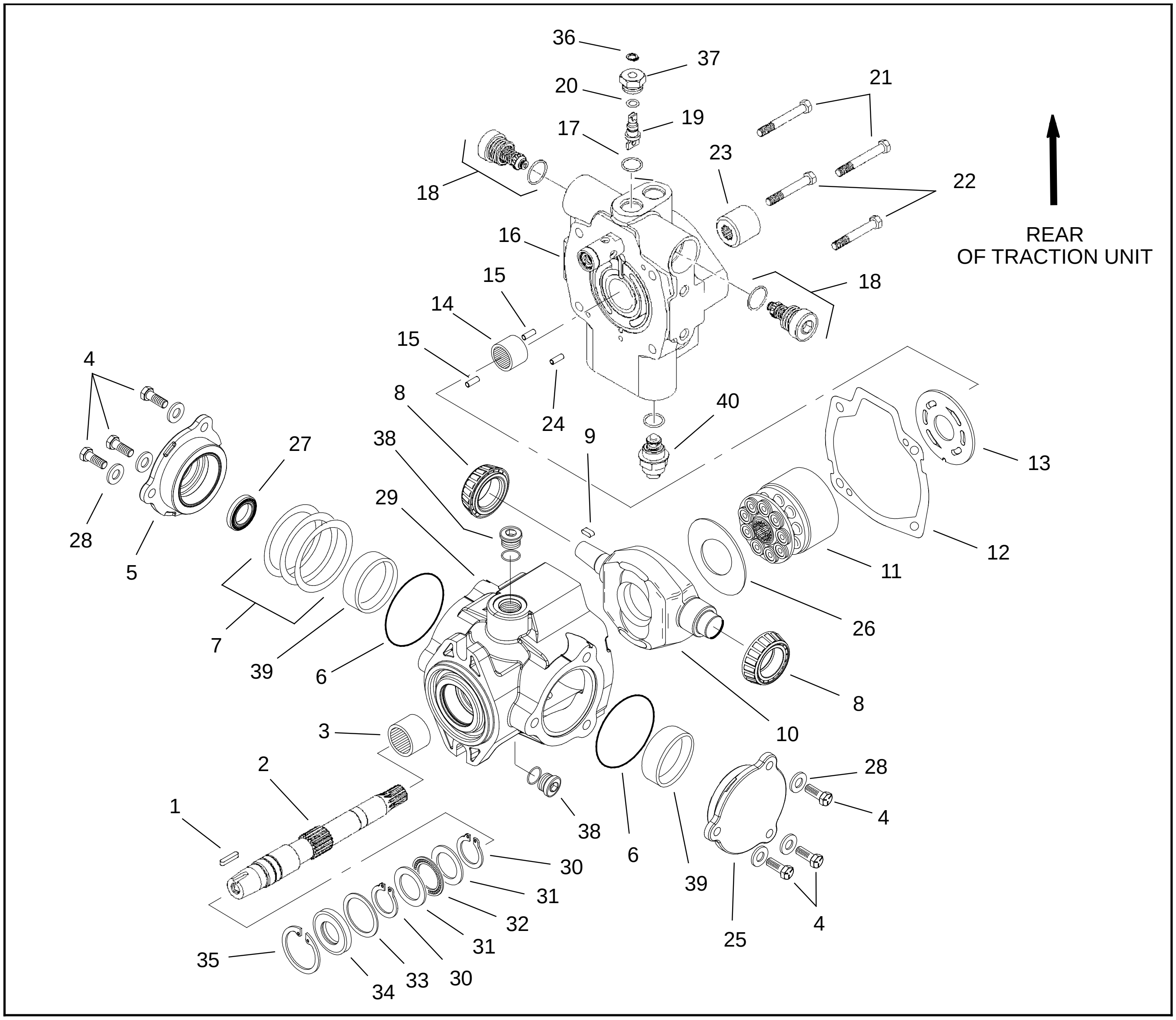
36
37
20
21
19
17
23
18
22
REAR
OF TRACTION UNIT
16
15
18
14
15
4
8
40
24
27
38
9
13
29
28
12
5
11
26
7
39
6
8
3
10
2
28
1
4
38
30
6
31
39
32
4
31
25
35
33
30
34

Figure 42

1. **Key**
2. **Drive shaft**
3. **Bearing**
4. **Cap screw (3 used per plate)**
5. **Cover plate**
6. **O-ring**
7. **Shim kit (for crush ring replacement)**
8. **Bearing cone**
9. **Key**
10. **Swash plate**
11. **Rotating kit**
12. **Gasket**
13. **Valve plate**
14. **Bearing**
15. **Dowel pin**
16. **Back plate**
17. **O-ring**
18. **Relief valve**
19. **Bypass valve**
20. **O-ring**
21. **Cap screw (2 used)**
22. **Cap screw (2 used)**
23. **Coupler**
24. **Roll pin**
25. **Cover plate**
26. **Swash plate insert**
27. **Shaft seal**
28. **Washer (3 used per plate)**
29. **Housing**
30. **Retaining ring**
31. **Bearing race**
32. **Thrust bearing**
33. **Washer**
34. **Shaft seal**
35. **Retaining ring**
36. **Retaining ring**
37. **Plug**
38. **Plug with O-ring (2 used)**
39. **Bearing cup**
40. **Shuttle relief valve with O-ring**

For repair of the piston (traction) pump, see Eaton, Medium Duty Piston Pump, Repair Information, Model 70160 Variable Displacement Piston Pump at the end of this chapter.

NOTE: The charge relief valve is attached to the piston pump back plate (Fig. 43). The back plate must be removed to service the relief valve.

NOTE: The piston (traction) pump is equipped with relief valves for both the forward and reverse direction. Due to engine output, it is unlikely that traction pressure will reach relief valve settings. If, however, a pump relief valve is leaking or otherwise faulty, traction performance would be affected.

IMPORTANT: The shim kit (item 7) is used to replace the original crush ring (not shown) in the cover plate (item 25). If the swash plate (item 10), cover plate (item 25) or housing (item 29) is replaced during servicing, the old crush ring must be replaced. See Piston Pump Crush Ring Replacement in this section in conjunction with the piston pump service manual at the end of this chapter.

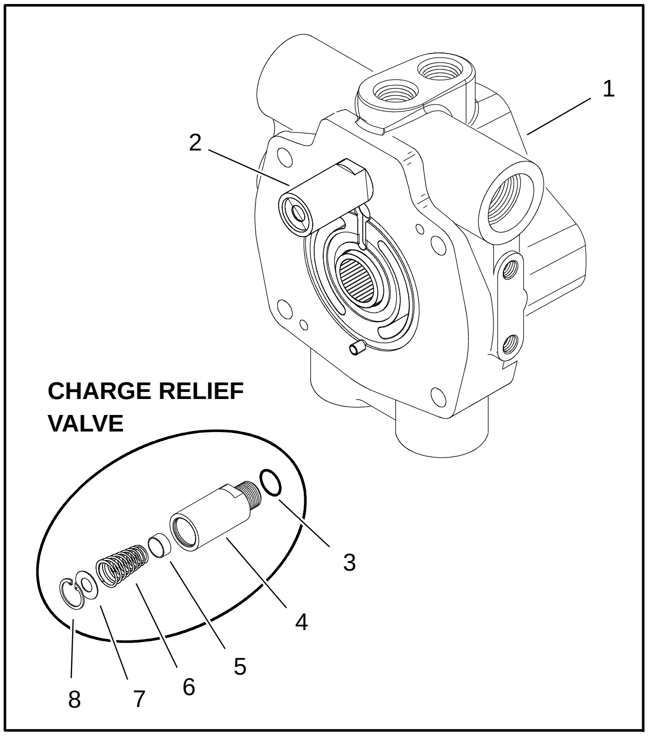

Figure 43

1. **Back plate**
2. **Charge relief valve**
3. **O-ring**
4. **Housing**
5. **Poppet**
6. **Spring**
7. **Washer**
8. **Retaining ring**

Piston Pump Crush Ring Replacement

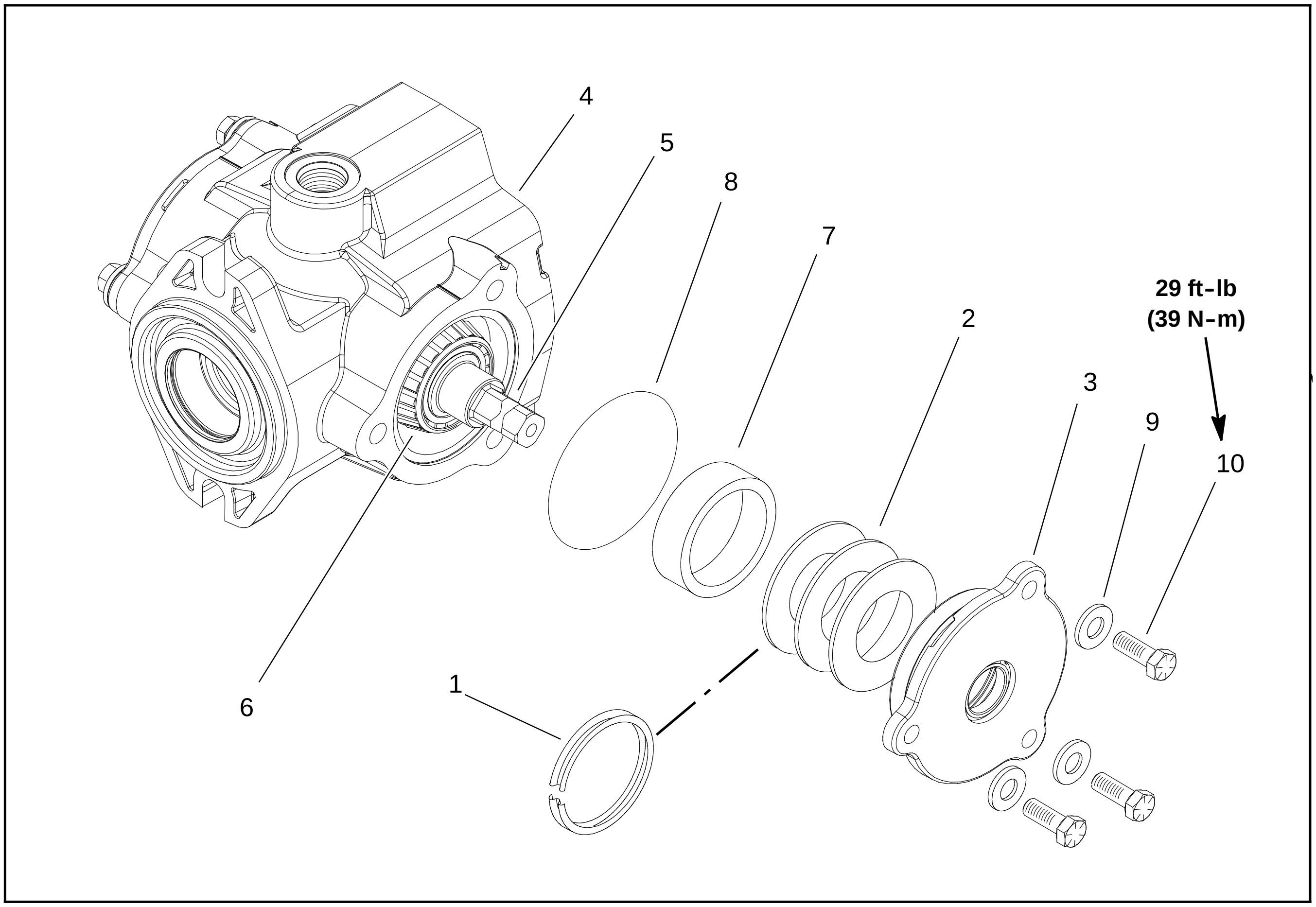

Figure 44

1. **Crush ring**
2. **Shims**
3. **Cover plate**
4. **Housing**
5. **Swash plate (control shaft)**
6. **Bearing cone**
7. **Bearing cup**
8. **O-ring**
9. **Washers (3 used)**
10. **Cap screws (3 used)**

Piston Pump Crush Ring Replacement (Fig. 44)

NOTE: The shims (item 2) replace the crush ring (item 1) in the cover plate. If the swash plate, cover plate or housing is replaced during servicing of the pump, the old crush ring can not be used to make sure of proper preload.

1. Remove crush ring from the cover plate. Measure thickness of crush ring.

2. Stack shims to the thickness of the crush ring.

3. Insert shims into the cover plate in the same location that the crush ring was removed from.

4. Assemble housing sub assembly consisting of the housing, swash plate, bearing cone, bearing cup and cover plate (see Eaton, Medium Duty Piston Pump, Repair Information, Model 70160 Variable Displacement Piston Pump at the end of this chapter).

5. Install washers and cap screws to the cover plate and housing. Torque cap screws to **29 ft-lbs (39 N-m)**.

6. Check torque required to rotate swash plate shaft. Torque should be from **15 to 25 in-lbs (1.7 to 2.8 N-m)**.

   A. If torque is **too low**, add additional shims and repeat steps 3 through 6 until the specified torque is achieved.

   B. If torque is **too high**, remove shims and repeat steps 3 through 6 until the specified torque is achieved.

7. Complete assembly of the pump (see Eaton, Medium Duty Piston Pump, Repair Information, Model 70160 Variable Displacement Piston Pump at the end of this chapter).

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Front Wheel Motors

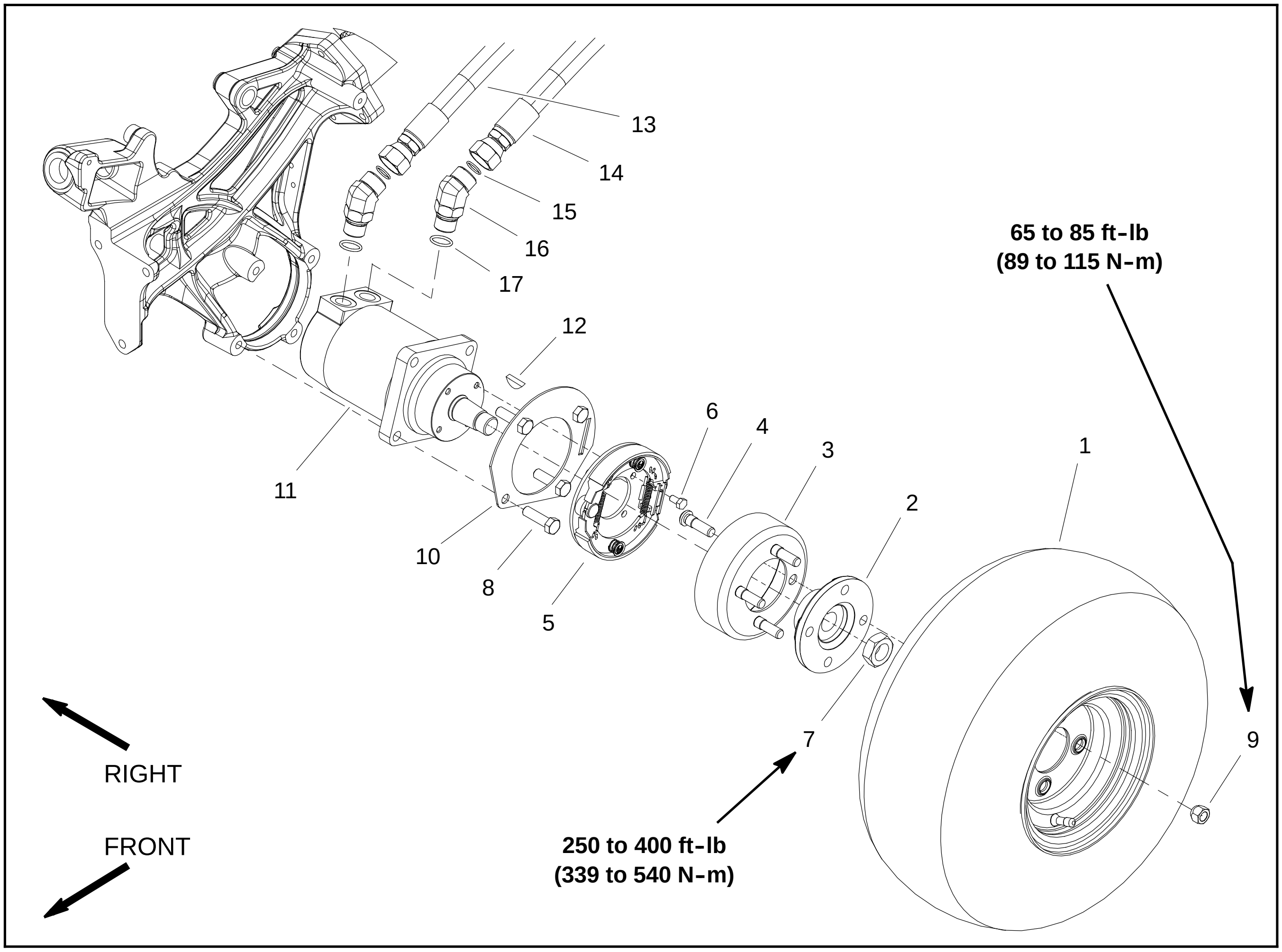

Figure 45

1. **Wheel assembly**
2. **Wheel hub**
3. **Brake drum**
4. **Wheel stud (4 per wheel)**
5. **Brake assembly (LH shown)**
6. **Cap screw (4 per brake)**
7. **Lock nut**
8. **Cap screw (4 per motor)**
9. **Lug nut (4 per wheel)**
10. **Brake lever tab**
11. **Hydraulic motor (LH shown)**
12. **Woodruff key**
13. **Hydraulic hose**
14. **Hydraulic hose**
15. **O-ring**
16. **45° hydraulic fitting (2 per motor)**
17. **O-ring**

Front Wheel Motor Removal (Fig. 45)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

2. Loosen, but do not remove, lug nuts (item 9) and lock nut (item 7). Loosen lock nut at least two (2) turns.

3. Chock front and rear of wheels not being lifted to prevent the machine from moving. Lift front wheel off the ground using a jack and place appropriate jack stands beneath the frame to support the machine.

4. Remove lug nuts and wheel assembly.

5. Remove e-ring and clevis pin that secure brake cable clevis to brake actuator lever (Fig. 46). Position brake cable clevis away from actuator lever.

IMPORTANT: DO NOT hit brake drum assembly, wheel hub puller or wheel motor with a hammer during wheel hub removal or installation. Hammering may cause damage to the wheel motor.

6. Make sure that lock nut on wheel motor shaft is loosened at least two (2) turns. Use hub puller (see Special Tools) to loosen brake drum assembly from wheel motor.

7. Remove lock nut and brake drum assembly. Locate and retrieve woodruff key (item 12).

8. Remove four (4) cap screws that secure brake assembly to wheel motor. Remove brake assembly. If brake service is required, see Brake Service in the Service and Repairs section of Chapter 7 – Chassis.

9. Thoroughly clean hydraulic line ends and fittings on wheel motor to prevent hydraulic system contamination.

10. Label hydraulic connections at wheel motor for assembly purposes.

11. Disconnect hydraulic lines from fittings on wheel motor. Allow lines to drain into a suitable container.

12. Mark wheel motor fitting orientation to allow correct assembly. Remove hydraulic fittings and O–rings from motor. Discard removed O–rings.

13. Put clean caps or plugs on disconnected lines and motor port openings to prevent contamination.

14. Support wheel motor to prevent it from falling. Remove four (4) cap screws that secure wheel motor and brake lever tab (item 10) to frame. Remove brake lever tab and wheel motor from machine.

Front Wheel Motor Installation (Fig. 45)

1. Position hydraulic wheel motor to the frame with motor ports facing up. Place brake lever tab (item 10) to wheel motor with slot toward rear of machine. Secure motor and brake lever tab to the frame with four (4) cap screws.

2. Remove plugs from wheel motor ports. Lubricate and place new O–rings onto fittings. Install fittings into motor openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

3. Remove caps from disconnected hydraulic lines.

4. Lubricate and position new O–rings to fittings on wheel motor. Use labels placed during the removal process to properly install hydraulic lines to wheel motor fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Position brake assembly to wheel motor and align brake actuator lever with slot in brake lever tab. Secure brake assembly to wheel motor with four (4) cap screws.

6. Thoroughly clean wheel motor shaft and wheel hub taper.

7. Install woodruff key into the wheel motor shaft keyslot. Align brake drum assembly with woodruff key and slide drum assembly onto motor shaft. Secure drum assembly with lock nut.

8. Secure brake cable clevis to brake actuator lever with clevis pin and e–ring (Fig. 46).

9. Install front wheel to machine and secure with four (4) lug nuts.

WARNING

Failure to maintain proper wheel lug nut and wheel hub lock nut torque could result in failure or loss of wheel and may result in personal injury.

10. Lower machine to ground. Torque lock nut from **250 to 400 ft–lb (339 to 540 N–m)** and wheel lug nuts from **65 to 85 ft–lb (89 to 115 N–m)**.

11. Check oil level in hydraulic reservoir and add correct oil if necessary.

12. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

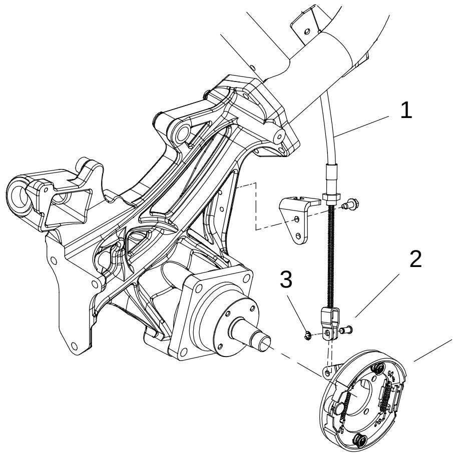

Figure 46

1. **Brake cable**
2. **Clevis pin**
3. **E–ring**
4. **Brake assembly**

Rear Wheel Motor (Optional 3WD)

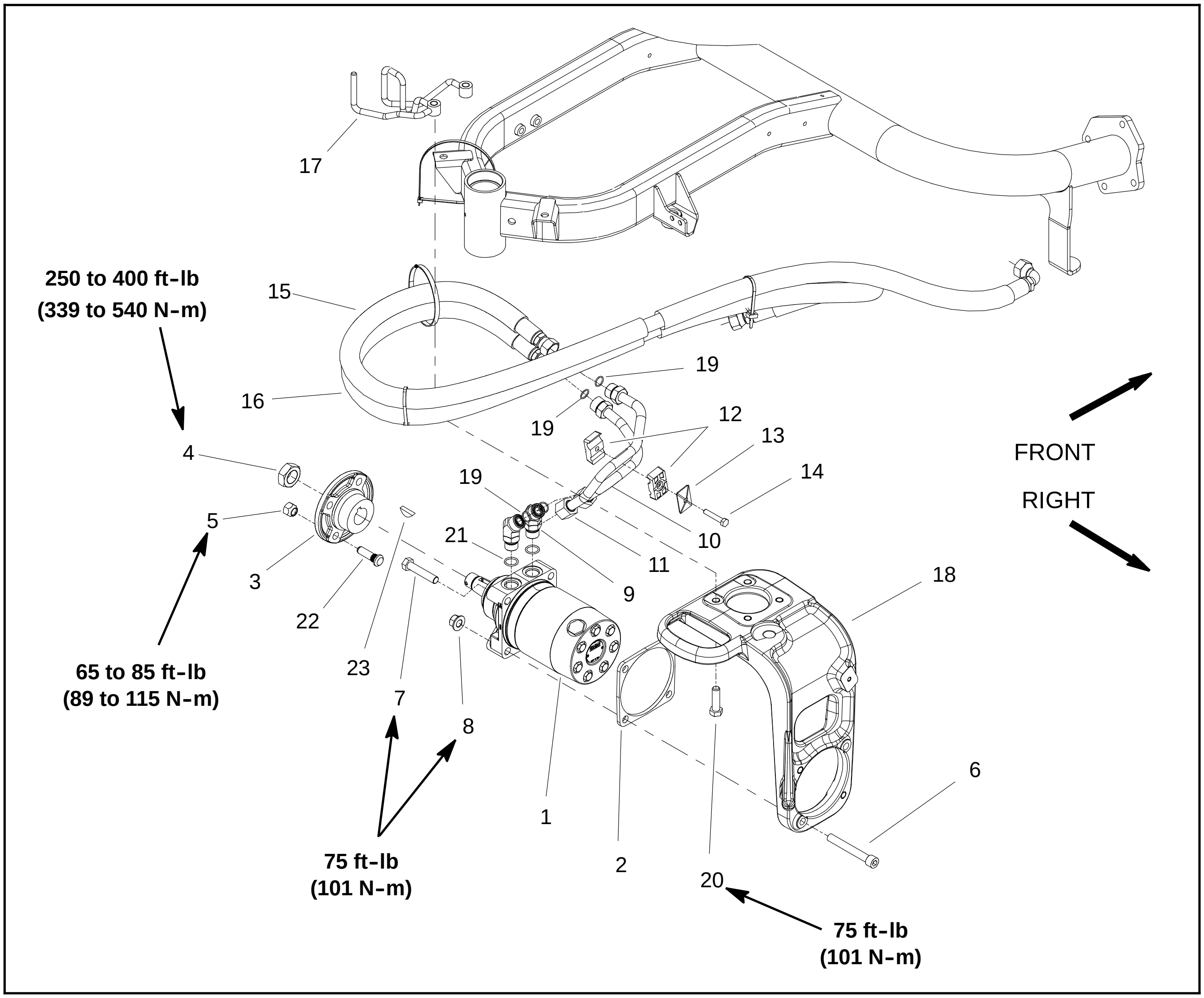
17
15
250 to 400 ft-lb
(339 to 540 N-m)
16
19
19
12
13
14
FRONT
RIGHT
4
5
19
21
10
11
9
18
3
22
23
7
8
65 to 85 ft-lb
(89 to 115 N-m)
1
2
20
6
75 ft-lb
(101 N-m)
75 ft-lb
(101 N-m)

Figure 47

1. **Wheel motor**
2. **Motor plate**
3. **Wheel hub**
4. **Lock nut**
5. **Lug nut (4 used)**
6. **Socket head screw (2 used)**
7. **Cap screw (2 used)**
8. **Lock nut (2 used)**
9. **45° hydraulic fitting (2 used)**
10. **Hydraulic tube**
11. **Hydraulic tube**
12. **Tube clamp (2 used)**
13. **Cover plate**
14. **Cap screw**
15. **Hydraulic hose**
16. **Hydraulic hose**
17. **Hose guide**
18. **Rear fork**
19. **O-ring**
20. **Cap screw (2 used)**
21. **O-ring**
22. **Wheel stud (4 used)**
23. **Woodruff key**

Rear Wheel Motor (Optional 3WD) Removal (Fig. 47)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

2. Loosen, but do not remove, rear wheel lug nuts (item 5) and lock nut (item 4). Loosen lock nut at least two (2) turns.

3. Chock both front wheels to prevent the machine from moving. Lift rear wheel off the ground using a jack and place appropriate jack stands beneath the frame to support the machine.

4. Remove lug nuts and rear wheel assembly.

IMPORTANT: DO NOT hit wheel hub, wheel hub puller or wheel motor with a hammer during wheel hub removal or installation. Hammering may cause damage to the wheel motor.

5. Use wheel hub puller (see Special Tools in this chapter) to loosen wheel hub from rear wheel motor.

6. Remove lock nut and wheel hub from rear wheel motor. Locate and retrieve woodruff key (item 23).

7. Thoroughly clean hydraulic tube ends and fittings on rear wheel motor to prevent hydraulic system contamination.

8. Label hydraulic connections at rear wheel motor for assembly purposes.

9. Disconnect hydraulic tubes from fittings on wheel motor. Allow lines to drain into a suitable container.

10. Put clean caps or plugs on disconnected tubes and fittings to prevent contamination.

11. Support wheel motor to prevent it from falling. Remove two (2) cap screws (item 7), two (2) socket head screws (item 6) and two (2) flange nuts (item 8) that secure wheel motor to rear fork. Remove rear wheel motor and motor plate (item 2) from machine.

12. If fitting removal from wheel motor is necessary, mark fitting orientation to allow correct assembly. Remove hydraulic fittings and O–rings from motor. Discard removed O–rings.

Rear Wheel Motor (Optional 3WD) Installation (Fig. 47)

1. If fittings were removed from rear wheel motor, lubricate and place new O–rings onto motor fittings. Install fittings into motor openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Place motor plate (item 2) on rear wheel motor and position motor to rear fork. Secure wheel motor to rear fork with two (2) cap screws (item 7), two (2) socket head screws (item 6) and two (2) flange nuts (item 8). Torque fasteners to **75 ft–lb (101 N–m)**.

3. Remove caps from disconnected hydraulic tubes.

4. Lubricate and position new O–rings to fittings on rear wheel motor. Use labels placed during the removal process to properly install hydraulic tubes to wheel motor fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Thoroughly clean wheel motor shaft and wheel hub taper.

6. Install woodruff key into the wheel motor shaft keyslot. Align wheel hub with woodruff key and slide wheel hub onto motor shaft. Secure hub with lock nut.

7. Install rear wheel to machine and secure with four (4) lug nuts.

WARNING

Failure to maintain proper wheel lug nut and wheel hub lock nut torque could result in failure or loss of wheel and may result in personal injury.

8. Lower machine to ground. Torque lock nut from **250 to 400 ft–lb (339 to 540 N–m)** and wheel lug nuts from **65 to 85 ft–lb (89 to 115 N–m)**.

9. Check oil level in hydraulic reservoir and add correct oil if necessary.

10. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

Wheel Motor Service

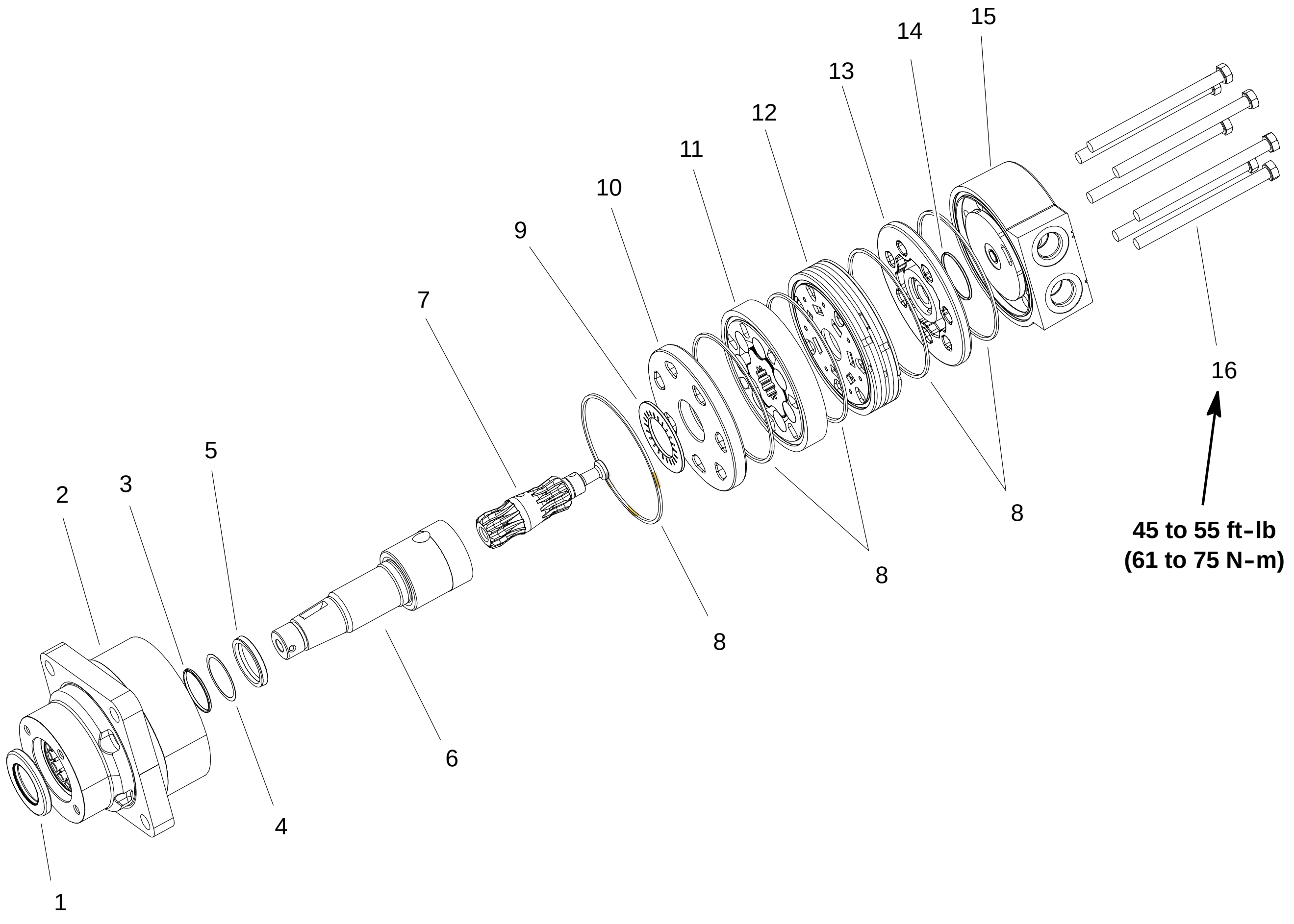

Figure 48

1. **Dirt seal**
2. **Housing**
3. **Back-up ring**
4. **Back-up washer**
5. **Shaft seal**
6. **Coupling shaft**
7. **Drive link**
8. **Seal ring (5 used)**
9. **Thrust bearing**
10. **Wear plate**
11. **Rotor assembly**
12. **Manifold assembly**
13. **Commutator assembly**
14. **Commutator seal**
15. **End cover**
16. **Cap screw (7 used)**

NOTE: The wheel motors used on your Greensmaster have the same basic construction. The left wheel motor(s) has a yellow sticker on the port side of the stator. The right wheel motor(s) has a reverse timed manifold.

NOTE: If machine is equipped with optional 3WD kit, the rear wheel motor has the same basic construction as the front wheel motors.

IMPORTANT: DO NOT interchange wheel motors on machine (i.e. do not put RH motor on left side of machine). If necessary, use parts catalog and part number on wheel motor to identify RH and LH motors.

NOTE: For wheel motor repair procedures, see the Parker Torqmotor™ Service Procedure (TC, TB, TE, TJ, TF, TG, TH and TL Series) at the end of this chapter.

IMPORTANT: If a wheel motor failure occurred, refer to Traction Circuit (Closed Loop) Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

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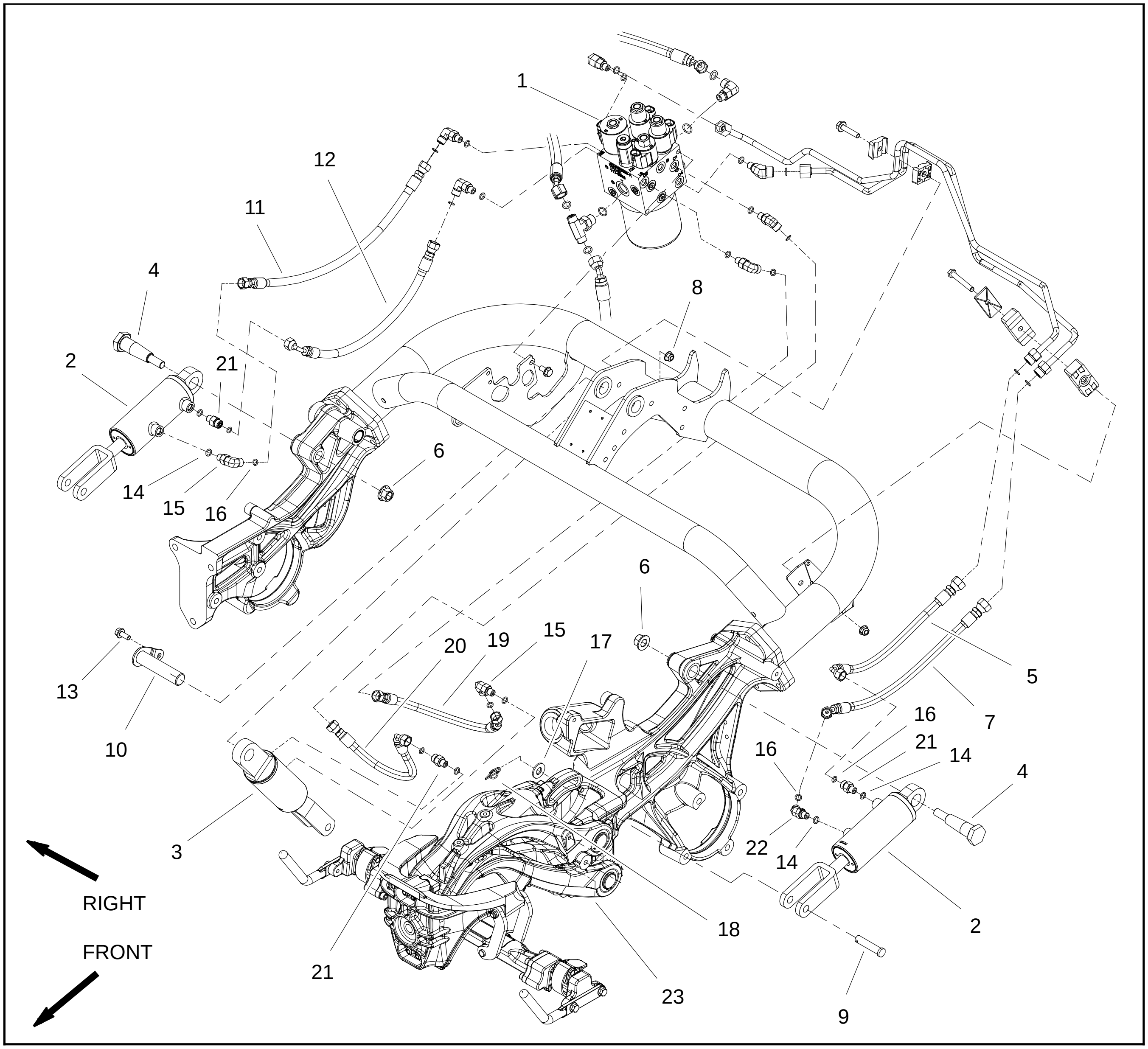
Lift Cylinders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16
14
4
3
22
14
RIGHT
FRONT
18
2
21
23
9

Figure 49

1. **Lift control manifold**
2. **Hydraulic lift cylinder (#2 and #3 CU)**
3. **Hydraulic lift cylinder (#1 CU)**
4. **Tapered pin (2 used)**
5. **Hydraulic hose**
6. **Lock nut (2 used)**
7. **Hydraulic hose**
8. **Flange nut**
9. **Clevis pin (3 used)**
10. **Pivot pin**
11. **Hydraulic hose**
12. **Hydraulic hose**
13. **Flange head screw**
14. **O-ring**
15. **90° hydraulic fitting (2 used)**
16. **O-ring**
17. **Washer (3 used)**
18. **Rue ring (3 used)**
19. **Hydraulic hose**
20. **Hydraulic hose**
21. **Straight hydraulic fitting (3 used)**
22. **45° hydraulic fitting**
23. **Cutting unit suspension**

Lift Cylinder Removal (Fig. 49)

1. Park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

2. Thoroughly clean hydraulic hose ends and fittings on lift cylinder to prevent hydraulic system contamination.

3. Label hydraulic hoses for assembly purposes.

WARNING

Make sure that cutting units are fully lowered before loosening hydraulic lines at lift cylinder. If cutting units are raised as lift cylinder hoses are loosened, cutting units may drop unexpectedly.

4. Disconnect hydraulic hoses from fittings on the lift cylinder. Allow hoses to drain into a suitable container. Install clean caps or plugs to hoses and cylinder fittings to prevent contamination.

5. Remove rue ring (item 18), washer (item 17) and clevis pin (item 9) that secure cylinder rod clevis to cutting unit suspension. Separate lift cylinder clevis from suspension.

6. Support lift cylinder to prevent it from dropping. Separate lift cylinder from frame:

   A. For front (#2 or #3 cutting unit) lift cylinder, remove lock nut (item 6) and tapered pin (item 4) that secure lift cylinder to frame.

   B. For center (#1 cutting unit) lift cylinder, remove flange nut (item 8) and flange head screw (item 13) that secure pivot pin (item 10) to frame. Slide pivot pin from frame and lift cylinder.

7. Remove hydraulic cylinder from machine.

8. If hydraulic fittings are to be removed from lift cylinder, mark fitting orientation to allow correct assembly. Remove hydraulic fittings and O–rings from cylinder. Discard removed O–rings.

9. Inspect threads and sealing surfaces of fittings and lift cylinder ports. Replace components if damage is found.

Lift Cylinder Installation (Fig. 49)

1. If fittings were removed from lift cylinder, lubricate and place new O–rings onto fittings. Install fittings into cylinder ports making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Position barrel end of lift cylinder to frame attachment point. Separate lift cylinder from frame:

   A. For front (#2 or #3 cutting unit) lift cylinder, make sure that tapered surfaces of pin (item 4) and frame mount are thoroughly clean. Slide tapered pin through lift cylinder and frame. Secure assembly with lock nut (item 6).

   B. For center (#1 cutting unit) lift cylinder, slide pivot pin (item 10) through frame and lift cylinder. Secure pivot pin to frame with flange head screw (item 13) and flange nut (item 8).

3. Position clevis of the lift cylinder to the cutting unit suspension. Secure cylinder clevis to suspension with clevis pin (item 9), washer (item 17) and rue ring (item 18).

4. Position clevis of the hydraulic cylinder to the lift arm. Install clevis pin and cotter pin through cylinder clevis.

5. Remove caps and plugs from disconnected hydraulic hoses and lift cylinder fittings.

6. Using labels placed during lift cylinder removal, lubricate new O–rings and connect hydraulic hoses to cylinder. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Check oil level in hydraulic reservoir and add correct oil if necessary.

8. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

Lift Cylinder Service

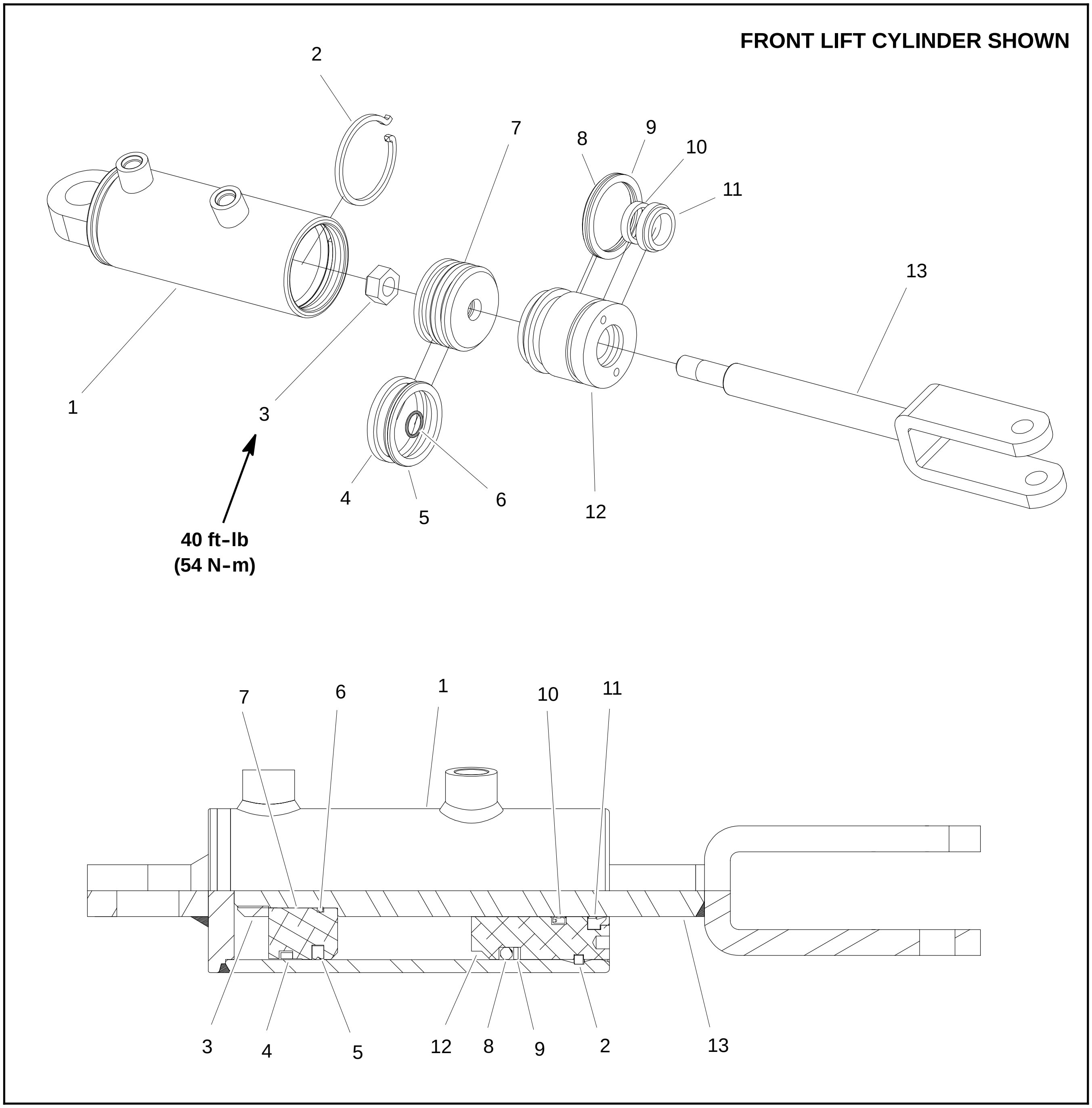

FRONT LIFT CYLINDER SHOWN
2
7
8
9
10
11
13
1
3
4
5
6
12
40 ft-lb
(54 N-m)
7
6
1
10
11
3
4
5
12
8
9
2
13

Figure 50

1. **Barrel**
2. **Retaining ring**
3. **Lock nut**
4. **Wear ring**
5. **Piston seal**
6. **O-ring**
7. **Piston**
8. **O-ring**
9. **Back-up ring**
10. **Head seal**
11. **Dust seal**
12. **Head**
13. **Shaft**

NOTE: The center lift cylinder (#1 cutting unit) has less stroke than the front lift cylinders (#2 and #3 cutting units) which are identical. Service procedures for all lift cylinders used on Greensmaster TriFlex Hybrid machines are the same.

Disassembly (Fig. 50)

1. Remove the oil from the lift cylinder by slowly pumping the cylinder shaft while holding the cylinder over a drain pan. Plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the lift cylinder in a vise; clamp on the rear mounting flange only. Do not close vise on the barrel.

2. Mount lift cylinder in a vise. Use of a vise with soft jaws is recommended.

3. Using a spanner wrench, rotate head clockwise until the edge of the retaining ring (item 2) appears in the barrel opening. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening. Rotate the head counter–clockwise to remove retaining ring from barrel and head.

4. Extract shaft, head and piston assembly by carefully twisting and pulling on the shaft.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vise.

5. Mount shaft securely in a vise by clamping on the clevis of the shaft. Remove lock nut and piston from the shaft. Slide head off the shaft.

6. Remove wear ring, piston seal and O–ring from the piston. Remove O–ring, back–up ring, head seal and dust seal from the head.

CAUTION

Use eye protection such as goggles when using compressed air to dry cylinder parts.

7. Wash lift cylinder parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

8. Carefully inspect internal surface of barrel for damage (deep scratches, out–of–round, etc.). Inspect shaft, head and piston for evidence of excessive scoring, pitting or wear. Replace entire cylinder if internal components are found to be worn or damaged.

Assembly (Fig. 50)

1. Make sure all lift cylinder parts are clean before assembly.

2. Coat new seal kit components with clean hydraulic oil.

   A. Install wear ring, piston seal and O–ring on the piston.

   B. Install O–ring, back–up ring, head seal and dust seal on the head.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vise.

3. Mount shaft securely in a vise by clamping on the clevis of the shaft. Use of a vise with soft jaws is recommended.

   A. Coat shaft with clean hydraulic oil.

   B. Carefully slide head onto the shaft.

   C. Install piston and lock nut onto the shaft. Torque lock nut from **40 ft–lb (54 N–m)**.

   D. Remove shaft from the vise.

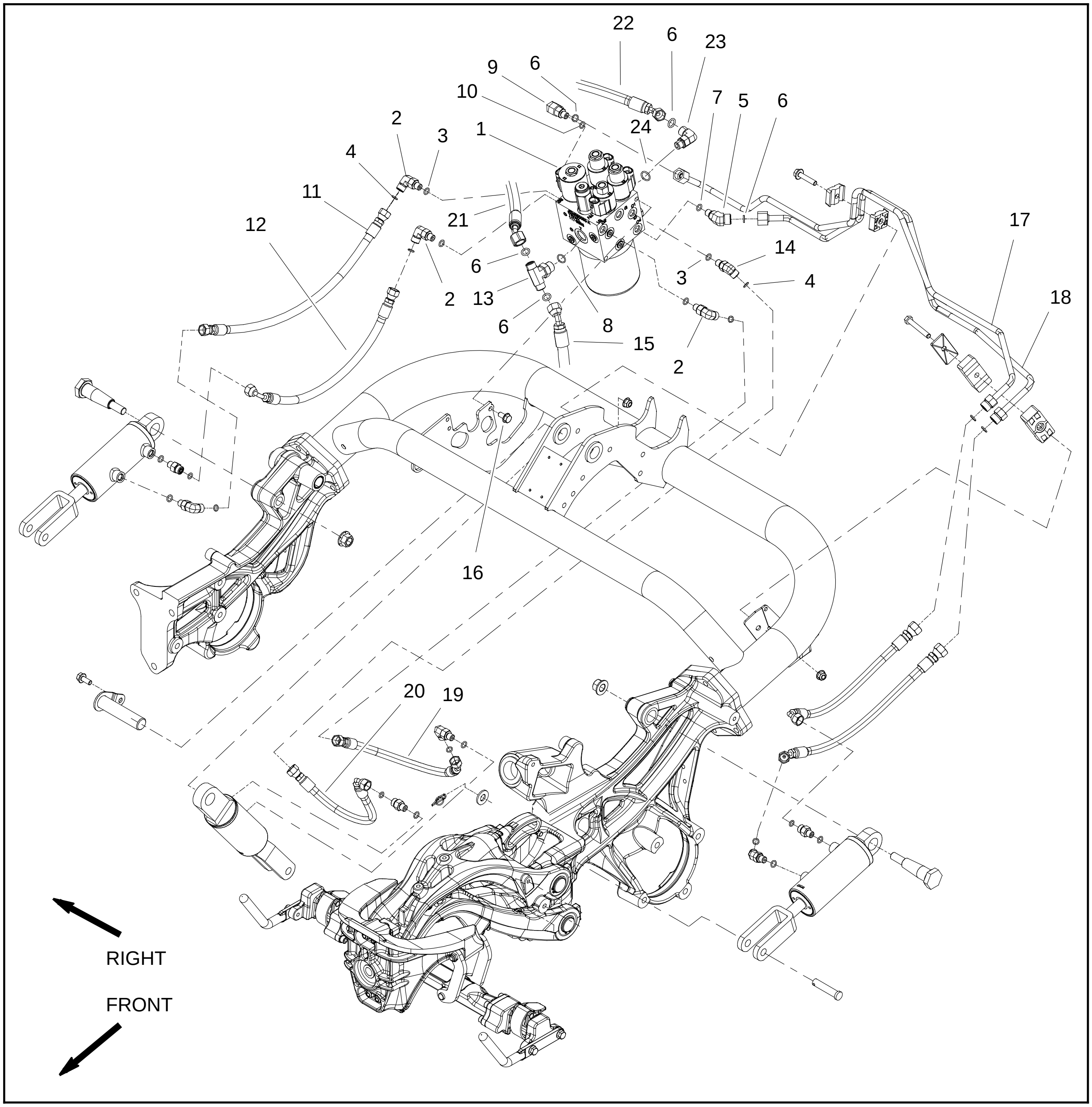
IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the rear mounting flange only. Do not close vise on the barrel.

4. Mount barrel in a vise. Use of a vise with soft jaws is recommended.

5. Coat all internal parts with a light coat of clean hydraulic oil. Slide piston, shaft and head assembly into the barrel being careful to not damage the seals.

6. Secure head in barrel by installing retaining ring. Align retaining ring hole in the head with the access slot in the barrel. Insert the retaining ring hook into the hole and rotate head clockwise until the retaining ring is completely pulled into the barrel and the ring ends are covered.

Lift Control Manifold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13
6
8
15
2
16
20
19
RIGHT
FRONT

Figure 51

1. Lift control manifold	9. 90° hydraulic fitting	17. Hydraulic tube
2. 90° hydraulic fitting (3 used)	10. O-ring	18. Hydraulic tube
3. O-ring	11. Hydraulic hose	19. Hydraulic hose
4. O-ring	12. Hydraulic hose	20. Hydraulic hose
5. 45° hydraulic fitting	13. Tee fitting	21. Hydraulic hose
6. O-ring	14. 45° hydraulic fitting	22. Hydraulic hose
7. O-ring	15. Hydraulic hose	23. 90° hydraulic fitting
8. O-ring	16. Flange head screw (2 used)	24. O-ring

NOTE: The ports on the lift control manifold are marked for easy identification of components. Example: S1 is the solenoid valve and P is the supply port (see Hydraulic Schematic to identify the function of the hydraulic lines and cartridge valves at each port location).

WARNING

If lift manifold is attached to machine, make sure that cutting units are fully lowered before loosening hydraulic lines or cartridge valves from lift manifold. If cutting units are raised as components are loosened in manifold, cutting units may drop unexpectedly.

Removal (Fig. 51)

1. Park machine on a level surface, engage parking brake, lower cutting units and stop the engine.

2. Remove right side cover next to operator seat to allow access to lift control manifold.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

3. Thoroughly clean hydraulic line ends and fittings on lift control manifold to prevent hydraulic system contamination.

4. Label all hydraulic and electrical connections for assembly purposes.

5. Disconnect wire harness connectors from solenoid valve coils on lift manifold.

IMPORTANT: Before disconnecting hydraulic lines from the manifold fittings, make sure each hose or tube is labeled to ensure it can be connected to the correct manifold fitting/port.

6. Disconnect hydraulic hose and tube assemblies and remove their respective O–rings from the manifold fittings. Allow hoses and tubes to drain into a suitable container. Install clean caps or plugs to hoses and manifold fittings to prevent contamination.

7. Remove two (2) flange head screws (item 16) that secure lift manifold to machine frame. Remove manifold assembly from the machine.

IMPORTANT: Before removing any hydraulic fitting from the hydraulic manifold, make sure the position of fitting is observed and recorded to ensure proper fitting installation.

IMPORTANT: A flow control orifice is placed beneath hydraulic fittings in lift control manifold ports C4 and C6. If either of these fittings is removed from the lift junction manifold, make sure to remove orifice and label its position for assembly purposes. Also note location of groove in orifice for assembly purposes.

8. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove hydraulic fittings and O–rings from manifold. Discard removed O–rings.

Installation (Fig. 51)

IMPORTANT: If installing an orifice in manifold port, make sure that orifice is flat in the base of the manifold port. Manifold damage is possible if the orifice is cocked in the cavity.

1. If fittings were removed from junction manifold, lubricate and place new O–rings onto fittings. Install fittings into manifold openings making sure that orifice (ports C4 and C6) is correctly placed before threading fitting into manifold. Use marks made during the removal process to correctly orientate fittings. Properly tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Position manifold assembly to the machine frame. Secure assembly to the frame with two (2) flange head screws (item 16).

3. Remove caps and plugs from disconnected hydraulic lines and manifold fittings.

4. Lubricate and position new O–rings to fittings on manifold. Use labels placed during the removal process to properly install hydraulic lines to manifold fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Connect wire harness connectors to solenoid valve coils on lift manifold.

6. Install right side cover.

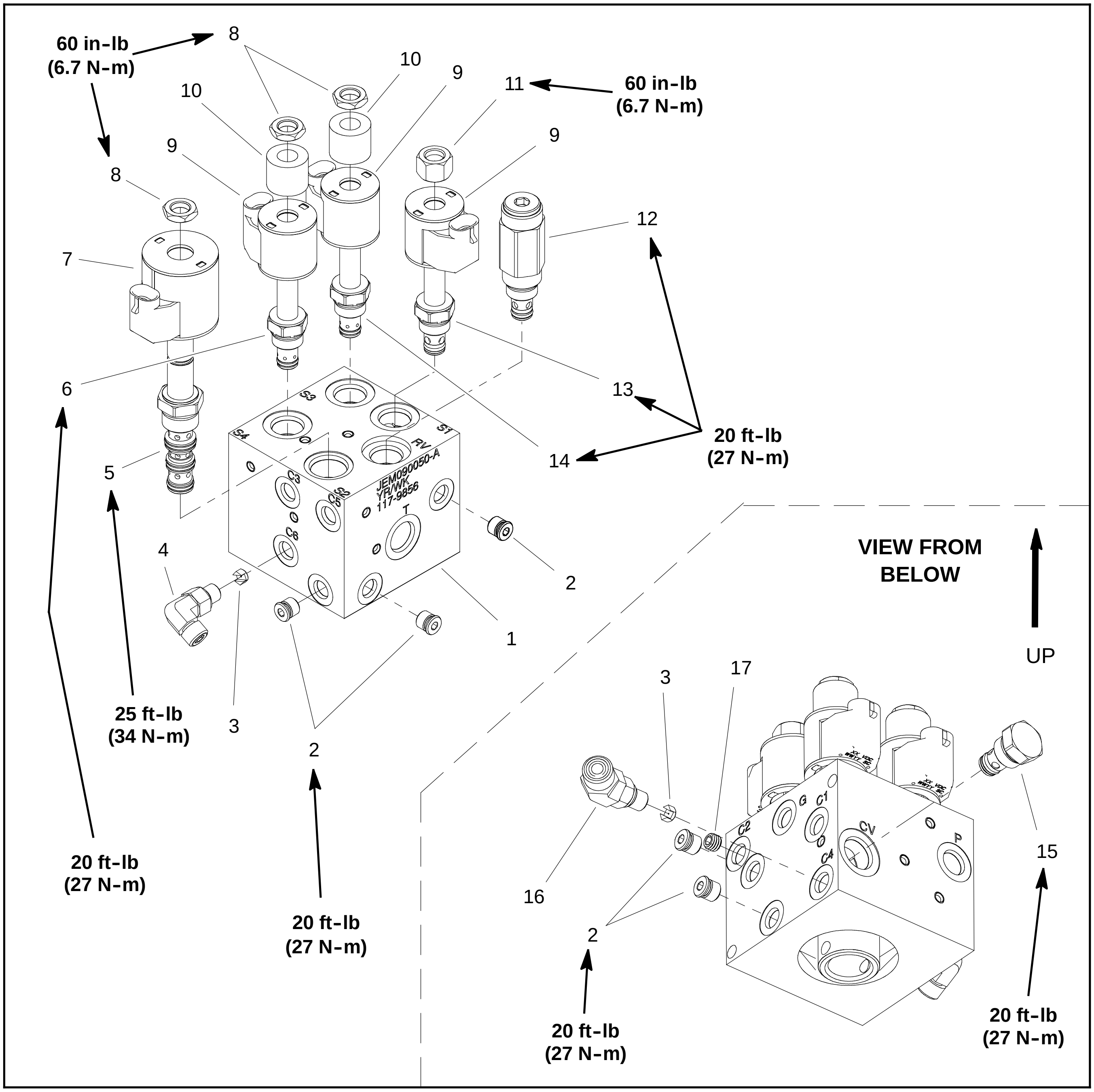
60 in-lb (6.7 N-m)
8
10
9
11
60 in-lb (6.7 N-m)
10
9
9
8
7
12
6
13
20 ft-lb (27 N-m)
14
5
4
2
1
VIEW FROM BELOW
UP
25 ft-lb (34 N-m)
3
2
3
17
20 ft-lb (27 N-m)
20 ft-lb (27 N-m)
16
2
15
20 ft-lb (27 N-m)
20 ft-lb (27 N-m)
S4
S3
S1
RV
C3
S2
C5
C6
T
JEM090050-A
YR/WK
117-9856
G
C1
C2
CV
C4
P

Figure 52

1. **Lift manifold**
2. **Zero leak plug (5 used)**
3. **Orifice (0.028) (ports C4 and C6)**
4. **90º hydraulic fitting**
5. **Solenoid valve (port S2)**
6. **Solenoid valve (port S4)**
7. **Solenoid coil**
8. **Nut**
9. **Solenoid coil (3 used)**
10. **Coil spacer**
11. **Nut**
12. **Relief valve (port RV)**
13. **Solenoid valve (port S1)**
14. **Solenoid valve (port S3)**
15. **Check valve (port CV)**
16. **45º hydraulic fitting**
17. **Orifice (0.037) (port C2)**

NOTE: The ports on the lift control manifold are marked for easy identification of components. Example: S1 is the solenoid valve and P is the supply port (see Hydraulic Schematic to identify the function of the hydraulic lines and cartridge valves at each port location).

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

WARNING

If lift manifold is attached to machine, make sure that cutting units are fully lowered before loosening hydraulic lines or cartridge valves from lift manifold. If cutting units are raised as components are loosened in manifold, cutting units may drop unexpectedly.

NOTE: The hydraulic manifold shown in Figure 52 uses several zero leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O–ring to provide a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plugs into the manifold, torque plugs to the values identified in Figure 52.

For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this section. Refer to Figure 52 for lift manifold cartridge valve and plug installation torque.

Control Manifold Cartridge Valve Service

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

1. Make sure the control manifold is clean before removing the cartridge valve from the control manifold.

2. If cartridge valve is solenoid operated, remove nut securing solenoid coil to the cartridge valve. Carefully slide coil off the valve.

IMPORTANT: Use care when handling the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction. When removing cartridge valve from manifold, make sure that deep well socket fully engages the valve base.

3. Remove cartridge valve from manifold using a deep socket wrench. Note correct location for O–rings, sealing rings and backup rings. Remove seal kit from cartridge valve and discard removed seals.

4. Visually inspect the port in the manifold for damage to the sealing surfaces, damaged threads and contamination.

5. Visually inspect cartridge valve for damaged sealing surfaces and contamination.

   A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing malfunction.

   B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

CAUTION

Use eye protection such as goggles when using compressed air.

6. Clean cartridge valve using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful not to damage cartridge. Use compressed air for cleaning.

7. Install the cartridge valve into the manifold:

   A. Lubricate new seal kit components with clean hydraulic oil and install on valve. The O–rings, sealing rings and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

   B. Dip assembled cartridge into clean hydraulic oil.

   IMPORTANT: Use care when handling the valve cartridge. Slight bending or distortion of the stem tube can cause binding and malfunction. When installing cartridge valve into manifold, make sure that deep well socket fully engages the valve base.

   C. Thread cartridge valve carefully into manifold port by hand until the top O–ring is met. The valve should go into manifold port easily without binding.

   D. Torque cartridge valve using a deep socket wrench to value identified in control manifold illustration.

8. If cartridge valve is solenoid operated, carefully install solenoid coil to the cartridge valve. Secure coil to valve with nut and torque nut to **60 in–lb (6.8 N–m)**.

9. If problems still exist after manifold assembly, remove cartridge valve and clean again or replace valve.

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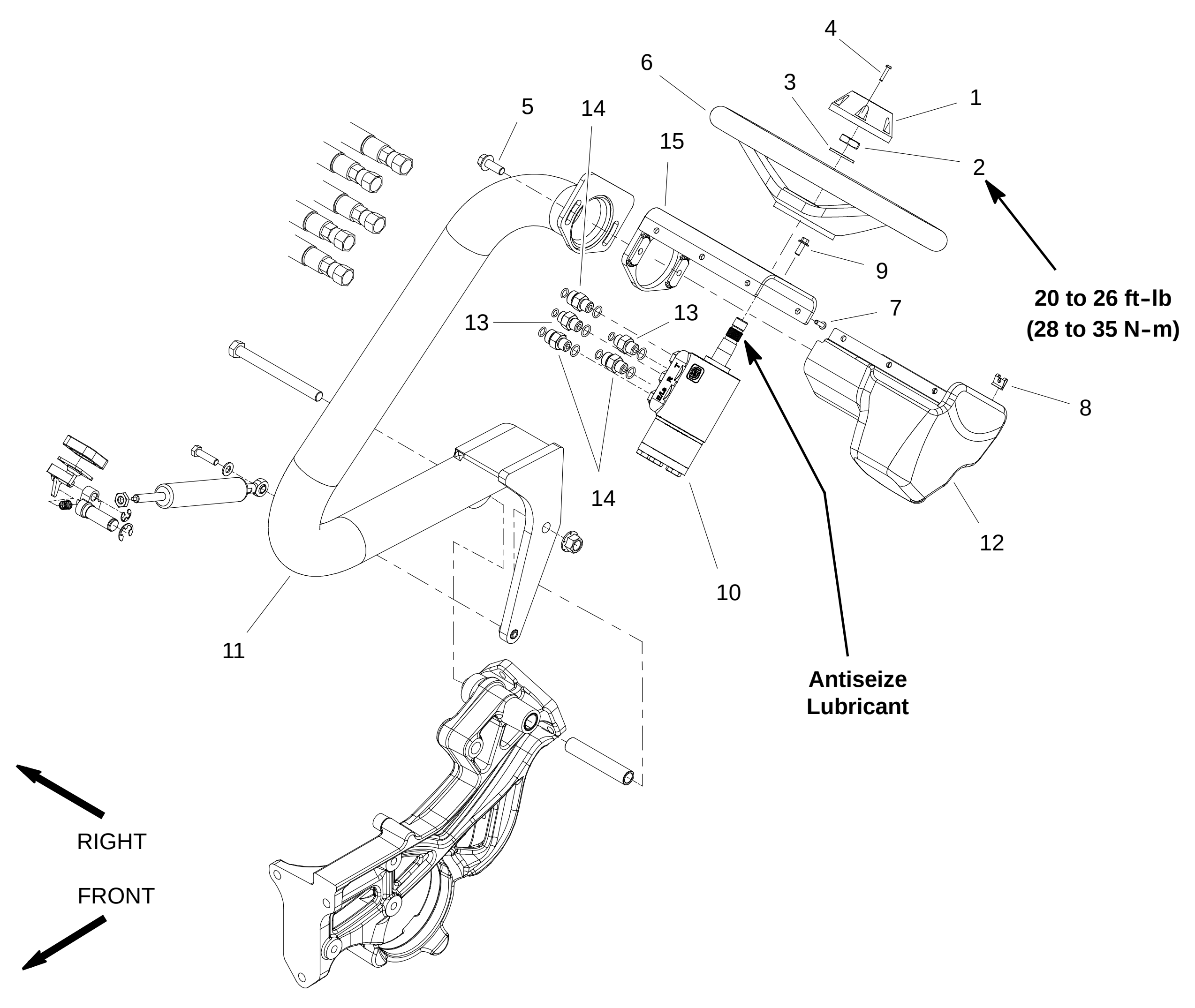
Power Steering Valve



4
6
3
1
5
14
15
2
9
13
13
7
20 to 26 ft–lb
(28 to 35 N–m)
8
14
12
10
11
Antiseize
Lubricant
RIGHT
FRONT

Figure 53

1. **Steering wheel cap**
2. **Hex nut**
3. **Flat washer**
4. **Screw**
5. **Flange head screw (2 used)**
6. **Steering wheel**
7. **Button head screw (6 used)**
8. **Tinnerman nut (6 used)**
9. **Flange head screw (4 used)**
10. **Power steering valve**
11. **Steering arm**
12. **Steering valve cover**
13. **Straight hydraulic fitting (2 used)**
14. **Straight hydraulic fitting (3 used)**
15. **Steering mount**

Removal (Fig. 53)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

2. Operate all hydraulic controls to relieve hydraulic system pressure.

3. Remove steering wheel from power steering valve:

   A. Remove screw and steering wheel cap from steering wheel.

   B. Remove hex nut and flat washer that secure steering wheel to power steering valve shaft.

   C. Use a suitable puller to remove steering wheel from power steering valve.

4. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

5. Loosen and remove four (4) flange head screws that secure power steering valve to steering mount.

6. Lower power steering valve (with hydraulic hoses attached) from steering mount.

7. Label all hydraulic hoses connected to the power steering valve for assembly purposes. Thoroughly clean hydraulic hose ends.

8. Disconnect hydraulic hoses from fittings on the power steering valve. Allow hoses to drain into a suitable container. Cap or plug hoses and control valve fittings to prevent contamination.

9. Remove steering valve from machine.

10.If necessary, remove hydraulic fittings and O–rings from power steering valve. Discard removed O–rings.

Installation (Fig. 53)

1. If fittings were removed from power steering valve, lubricate and place new O–rings onto fittings. Install fittings into steering valve openings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Position power steering valve to steering mount.

3. Using labels placed during control valve removal, lubricate new O–rings and connect hydraulic hoses to power steering valve. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Slide power steering valve (with hydraulic hoses attached) to steering mount. Secure steering valve to mount with four (4) flange head screws.

5. Install steering wheel to power steering valve:

   A. Apply antiseize lubricant to splines of power steering valve shaft taking care to keep antiseize lubricant from tapered surface of shaft. Slide steering wheel onto steering valve.

   B. Secure steering wheel to steering valve shaft with flat washer and hex nut. Torque nut from **20 to 26 ft–lb (28 to 35 N–m)**.

   C. Install steering wheel cap to steering wheel.

6. Check fluid level in hydraulic oil reservoir and adjust as required.

7. After assembly is completed, rotate steering wheel in both directions to verify that there are no leaks from hydraulic connections.

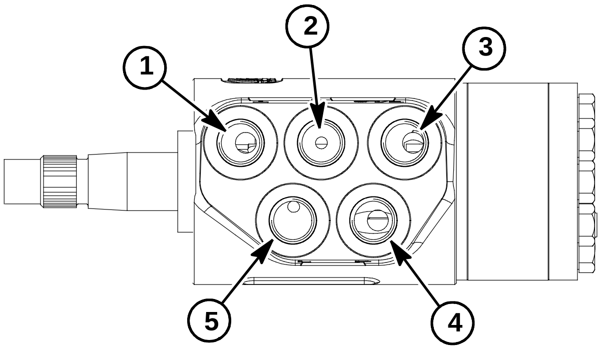
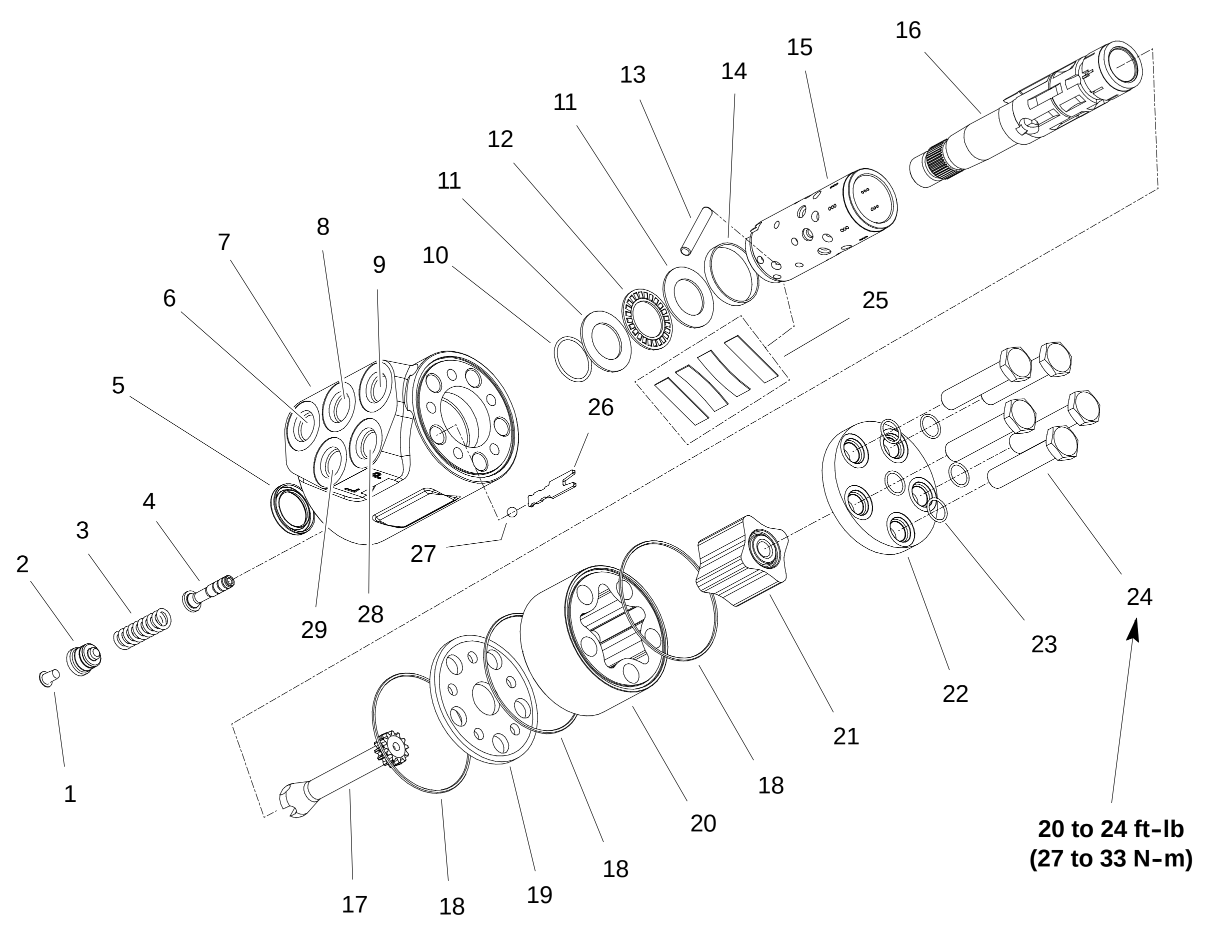


Figure 54

1. **T port**
2. **R port**
3. **E/Ls port**
4. **P port**
5. **L port**

Power Steering Valve Service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22
21
1
18
20
17
18
19
18

20 to 24 ft-lb
(27 to 33 N-m)

Figure 55

1. **Plug**
2. **Plug**
3. **Spring**
4. **Relief valve**
5. **Dust seal**
6. **T port**
7. **Housing**
8. **R port**
9. **E port**
10. **Shaft seal**
11. **Thrust washer**
12. **Bearing**
13. **Cross pin**
14. **Ring**
15. **Sleeve**
16. **Spool**
17. **Cardan shaft**
18. **O-ring**
19. **Distribution plate**
20. **Outer gearwheel**
21. **Inner gearwheel**
22. **End cover**
23. **O-ring (5 used)**
24. **Cap screw (5 used)**
25. **Spring set**
26. **Ball stop**
27. **Ball**
28. **P port**
29. **L port**

NOTE: For service of the power steering valve, see the Sauer/Danfoss Steering Unit Type OSPM Service Manual at the end of this chapter.

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Steering Cylinder

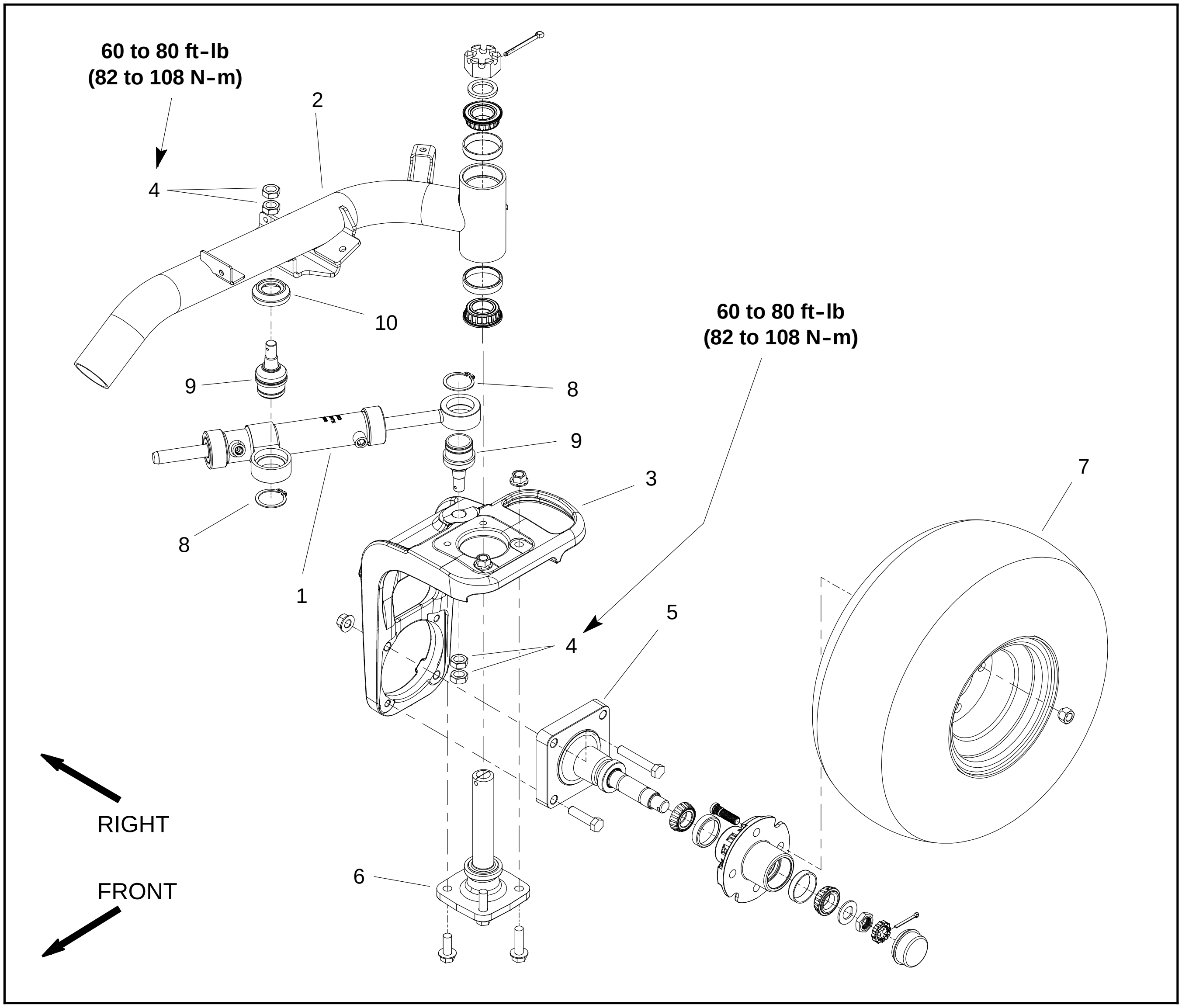

Figure 56

1. Steering cylinder	**5. Rear wheel spindle**	**8. Retaining ring (2 used)**
2. Frame	**6. Steering spindle**	**9. Ball joint (2 used)**
3. Rear steering fork	**7. Rear wheel assembly**	**10. Cylinder spacer**
4. Jam nut (4 used)		

Removal (Fig. 56)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

2. Operate all hydraulic controls to relieve hydraulic system pressure.

3. To allow easier access to steering cylinder, raise and support tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 - Chassis).

4. Label steering cylinder hydraulic hoses for assembly purposes. Thoroughly clean hydraulic hose ends prior to disconnecting the hoses from steering cylinder.

5. Remove hose assemblies and O–rings from hydraulic fittings at the cylinder. Allow hoses to drain into a suitable container.

6. Put clean caps or plugs on disconnected hoses and fittings to prevent contamination.

7. Support steering cylinder to prevent it from falling.

8. Remove jam nuts that secure cylinder ball joints to frame and rear fork assembly.

9. Separate cylinder ball joints from frame and rear fork. Remove steering cylinder from machine. Locate and retrieve cylinder spacer (item 10).

10. If necessary, remove hydraulic fittings from steering cylinder and discard O–rings.

11. If necessary, remove ball joints from steering cylinder. Discard removed ball joints.

Installation (Fig. 56)

1. If ball joints were removed from steering cylinder, press new ball joints into steering cylinder and secure with retaining rings.

2. If fittings were removed from steering cylinder, lubricate and place new O–rings onto fittings. Install fittings into cylinder port openings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

3. Thoroughly clean tapered surfaces of steering cylinder ball joints and cylinder attachment bores on machine.

4. Place cylinder spacer (item 10) onto cylinder barrel ball joint.

5. Insert ball joints of cylinder into attachment points on frame and rear fork assembly.

6. Secure both steering cylinder ball joints to machine with two (2) jam nuts (item 4). Install first jam nut and torque from **60 to 80 ft–lb (82 to 108 N–m)**. Then, while holding first jam nut with wrench, tighten second jam nut and torque from **60 to 80 ft–lb (82 to 108 N–m)**.

7. Remove caps and plugs from disconnected hoses and fittings.

8. Lubricate new O–rings and connect hydraulic hoses to steering cylinder (Fig. 57). Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

9. Lower and secure tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 – Chassis).

10. Check fluid level in hydraulic oil reservoir and adjust as required.

11. After assembly is completed, operate steering cylinder to verify that hydraulic hoses and fittings are not contacted by anything and that there are no leaks. Also, make sure that a clockwise rotation of the steering wheel turns the rear wheel for a right turn.

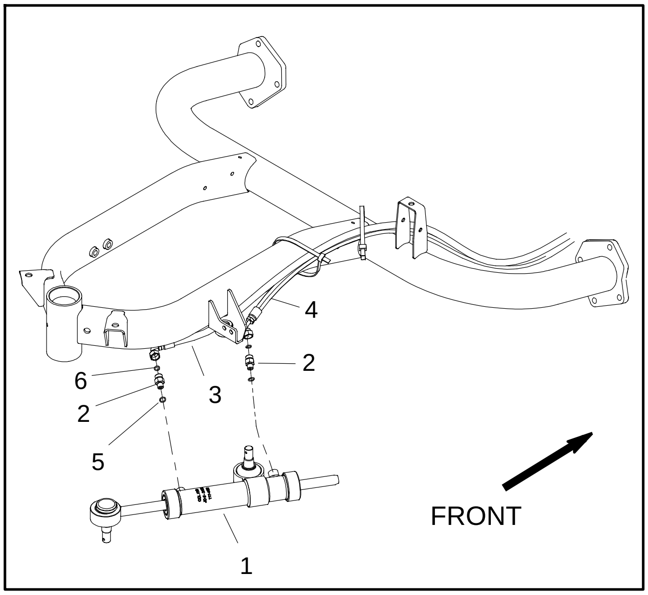

Figure 57

1. **Steering cylinder**
2. **Hyd fitting (2 used)**
3. **Hyd hose**
4. **Hyd hose**
5. **O–ring**
6. **O–ring**

Steering Cylinder Service

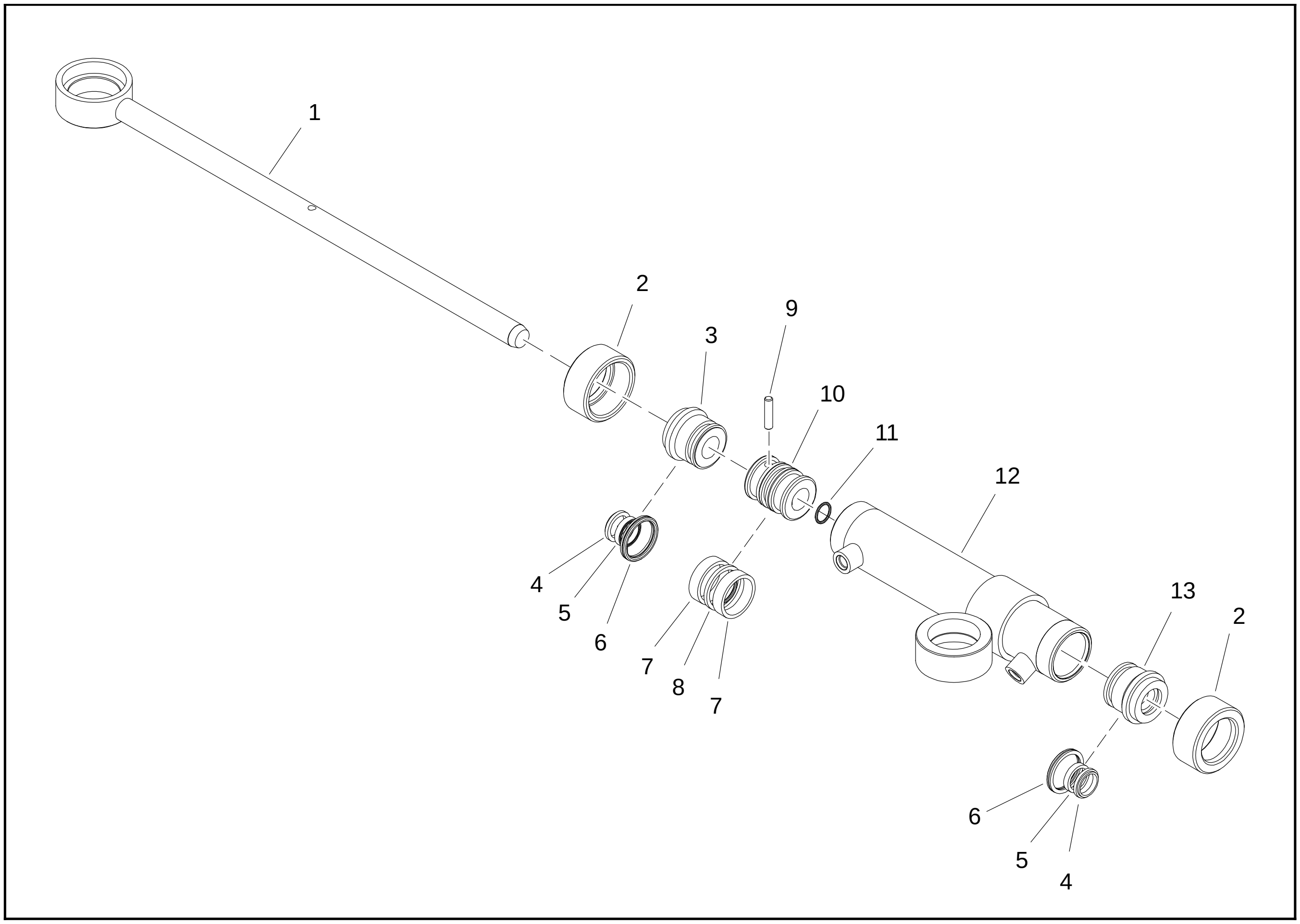

Figure 58

1. **Shaft**
2. **Collar**
3. **Head (ball joint end)**
4. **Dust seal**
5. **Shaft seal**
6. **O-ring and backup ring**
7. **Wear ring**
8. **Piston seal**
9. **Dowel pin**
10. **Piston**
11. **O-ring**
12. **Barrel**
13. **Head (non-ball joint end)**

Disassembly (Fig. 58)

1. Pump oil out of cylinder into a drain pan by slowly moving shaft in and out of cylinder bore. Plug ports and clean outside of cylinder.

IMPORTANT: To prevent damage when clamping cylinder barrel in a vise, clamp only on ball joint location. Do not clamp the vise jaws against the cylinder barrel or shaft surface.

2. Mount cylinder in a vise by clamping vise on barrel ball joint location of cylinder. Use of a vise with soft jaws is recommended.

3. Using a pipe wrench, carefully remove both collars (item 2) from cylinder barrel.

4. Carefully remove non–ball joint end head (item 13) from end of barrel.

5. Grasp end of shaft and use a twisting and pulling motion to carefully extract shaft assembly (with collar, ball joint end head and piston) from cylinder barrel.

6. Remove wear ring from piston to allow access to dowel pin (item 9) that secures piston to shaft.

7. Use press to carefully remove dowel pin (item 9) from piston and shaft.

8. Slide piston (item 10), ball joint end head (item 3) and collar (item 2) from shaft.

9. Remove and discard seals, back–up rings, wear rings and O–rings from piston and both heads.

CAUTION

Use eye protection such as goggles when using compressed air to dry cylinder parts.

10. Wash cylinder parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper or cloth towels. Lint from towels in a hydraulic system will cause damage.

11. Carefully inspect internal surface of barrel for damage (deep scratches, out–of–round, etc). Inspect shaft, both heads and piston for evidence of excessive scoring, pitting or wear. Replace entire steering cylinder if internal components are damaged.

Assembly (Fig. 58)

1. Put a coating of clean hydraulic oil on all new seals, back–up rings, wear rings and O–rings.

2. Install new shaft seal, dust seal, back up ring and O–ring onto both heads (items 3 and 13).

3. Install piston seal and O–ring to the piston (item 10). Also, install one (1) wear ring onto piston in groove that does not contain hole for dowel pin. Second wear ring will be installed after piston is secured to shaft.

4. Carefully slide collar (item 2), ball joint end head (item 3), second piston wear ring and piston (item 10) onto shaft taking care to not damage seals. Make sure that hole in piston for dowel pin is orientated toward ball joint end of shaft.

5. Align holes in piston and shaft. Use press to install dowel pin (item 9) into piston and shaft. Make sure that dowel pin ends do not extend into the piston wear ring location.

6. Install second wear ring into piston groove that contains hole for dowel pin.

7. Coat all internal cylinder parts with a light coat of clean hydraulic oil. Carefully slide shaft assembly (with collar, ball joint end head and piston) into the barrel being careful to not damage seals.

8. Lubricate non–ball joint end head (item 13) assembly with clean hydraulic oil and carefully slide it onto shaft and into barrel.

9. Using a pipe wrench, install collars to secure both heads in cylinder barrel.

Hydraulic Reservoir

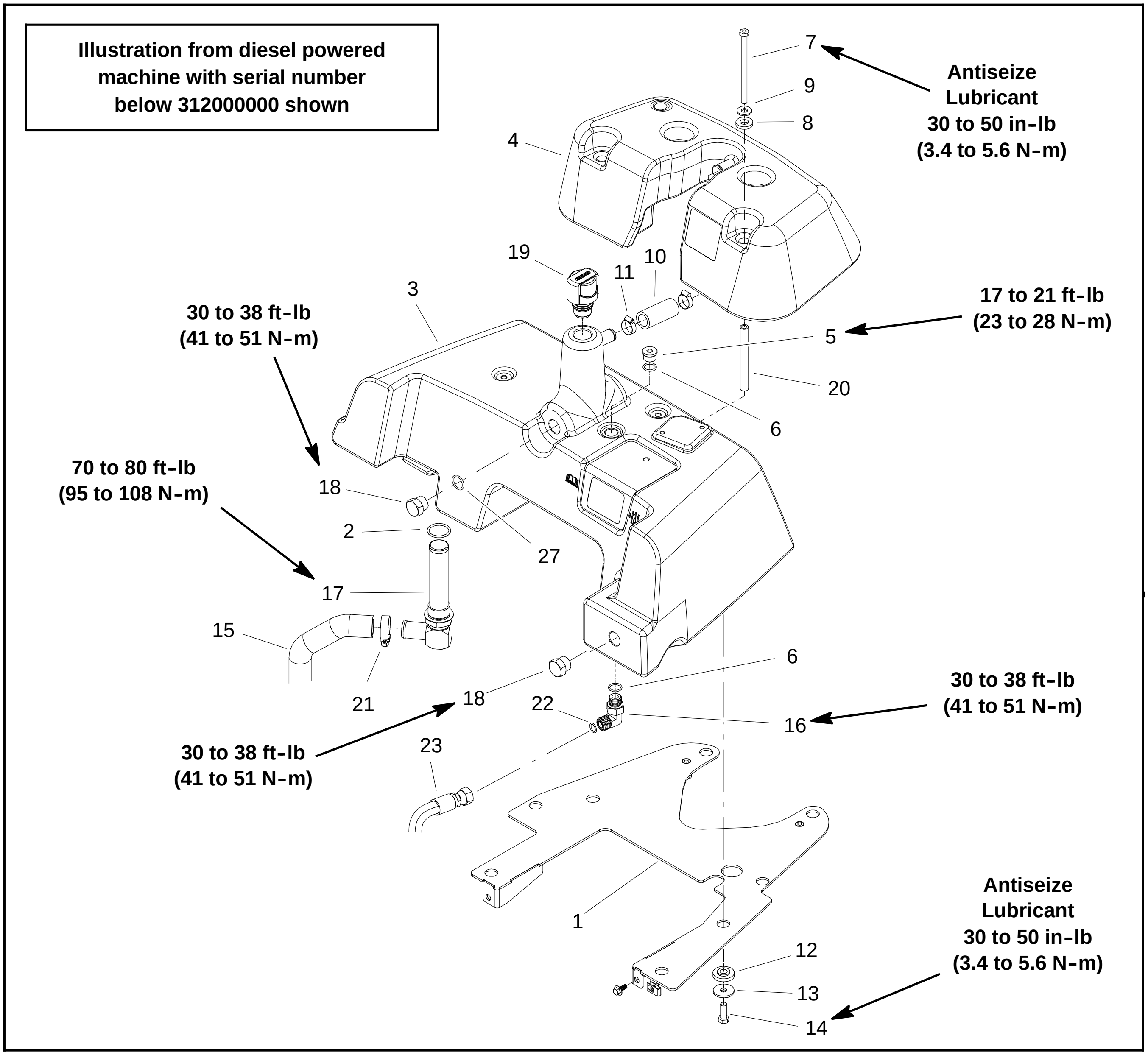
Illustration from diesel powered machine with serial number below 312000000 shown

Antiseize Lubricant 30 to 50 in-lb (3.4 to 5.6 N-m)

17 to 21 ft-lb (23 to 28 N-m)

30 to 38 ft-lb (41 to 51 N-m)

70 to 80 ft-lb (95 to 108 N-m)

30 to 38 ft-lb (41 to 51 N-m)

30 to 38 ft-lb (41 to 51 N-m)

Antiseize Lubricant 30 to 50 in-lb (3.4 to 5.6 N-m)

Figure 59

1. **Tank mount plate**
2. **O-ring**
3. **Hydraulic reservoir**
4. **Tank cover**
5. **Plug**
6. **O-ring**
7. **Cap screw (4 used)**
8. **Neoprene washer (4 used)**
9. **Flat washer (4 used)**
10. **Overflow hose**
11. **Hose clamp (2 used)**
12. **Flange bushing (4 used)**
13. **Flat washer (4 used)**
14. **Cap screw (4 used)**
15. **Suction hose**
16. **90^{o} hydraulic fitting**
17. **Strainer**
18. **Plug**
19. **Breather**
20. **Spacer (4 used)**
21. **Hose clamp**
22. **O-ring**
23. **Hydraulic hose**

Removing Hydraulic Reservoir (Fig. 59)

1. Park machine on a level surface, set brake, lower cutting units and stop engine. Remove key from the ignition switch.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

2. If machine is equipped with optional Turf Guardian™ Leak Detector System, remove leak detector tank and solenoid valve assembly (see Leak Detector Tank (Machines Equipped with Optional Turf Guardian™ Leak Detector System) and Leak Detector Solenoid Valve Assembly (Machines Equipped with Optional Turf Guardian™ Leak Detector System) in this section).

3. Remove four (4) cap screws (item 7), flat washers (item 9), neoprene washers (item 8) and spacers (item 20) that secure tank cover to hydraulic reservoir.

4. Loosen hose clamp and disconnect overflow hose (item 10) from tank cover barb.

NOTE: On Greensmaster 3320 machines with serial number above 312000000, the fuel system carbon canister is attached to the reservoir cover. See Fuel System Carbon Canister (Serial Number Above 312000000) in the Service and Repairs section of Chapter 3 – Gasoline for information on disconnecting the canister.

5. Remove tank cover from machine.

6. Completely drain hydraulic oil from hydraulic reservoir through gear pump suction hose into a suitable container.

7. Label hydraulic reservoir hydraulic hoses for assembly purposes. Thoroughly clean hydraulic hose ends prior to disconnecting the hoses from hydraulic reservoir fittings.

8. Remove hose assemblies and O–rings from hydraulic reservoir fittings. Allow hoses to drain into a suitable container.

9. Put clean caps or plugs on disconnected hoses and fittings to prevent contamination.

10. To allow easier access to fasteners that secure hydraulic reservoir, raise and support tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 – Chassis).

11. Remove four (4) cap screws (item 14), flat washers (item 13) and flange bushings (item 12) that secure the hydraulic reservoir (item 3) to the tank mount plate.

12. Remove hydraulic reservoir from machine.

13. If hydraulic fittings are to be removed from reservoir, mark fitting orientation to allow correct assembly. Remove hydraulic fittings and plugs from hydraulic reservoir as needed. Discard O–rings from removed fittings and plugs.

14. Clean hydraulic reservoir and reservoir components with clean solvent. Inspect reservoir for leaks, cracks or other damage.

Installing Hydraulic Reservoir (Fig. 59)

IMPORTANT: When installing tank cover and reservoir to machine, do not over–tighten cap screws. Threads in reservoir may become damaged.

1. Lubricate and place new O–rings onto all removed fittings and plugs. Install fittings and plugs into reservoir openings. Use marks made during the removal process to correctly orientate fittings. Refer to Figure 59 for reservoir fitting and plug installation torque specifications.

2. Position hydraulic reservoir onto the tank mount plate.

3. Apply antiseize lubricant to threads of four (4) cap screws (item 14). Secure hydraulic reservoir to the tank mount plate with four (4) cap screws, flat washers (item 13) and flange bushings (item 12). Torque cap screws from **30 to 50 in–lb (3.4 to 5.6 N–m)**.

4. Lower and secure tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 – Chassis).

5. Remove caps and plugs from disconnected hydraulic hoses and reservoir fittings.

6. Lubricate and position new O–rings to fittings on reservoir. Use labels placed during the removal process to properly install hydraulic lines to reservoir fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. If machine is equipped with optional Turf Guardian™ Leak Detector System, install leak detector tank and solenoid valve assembly (see Leak Detector Tank (Machines Equipped with Optional Turf Guardian™ Leak Detector System) and Leak Detector Solenoid Valve Assembly (Machines Equipped with Optional Turf Guardian™ Leak Detector System) in this section).

NOTE: On Greensmaster machines with serial number above 312000000, see Fuel System Carbon Canister (Serial Number Above 312000000) in the Service and Repairs section of Chapter 3 – Gasoline for information on connecting the fuel system carbon canister.

8. Position tank cover to top of hydraulic reservoir.

9. Connect overflow hose (item 10) to tank cover barb and secure with hose clamp.

10. Apply antiseize lubricant to threads of four (4) cap screws (item 7). Secure tank cover to hydraulic reservoir with four (4) spacers (item 20), cap screws (item 7), flat washers (item 9) and neoprene washers (item 8). Torque cap screws from **30 to 50 in–lb (3.4 to 5.6 N–m)**.

11. Fill hydraulic reservoir with new hydraulic oil.

Leak Detector Tank (Machines Equipped with Optional Turf Guardian^{TM} Leak Detector System)

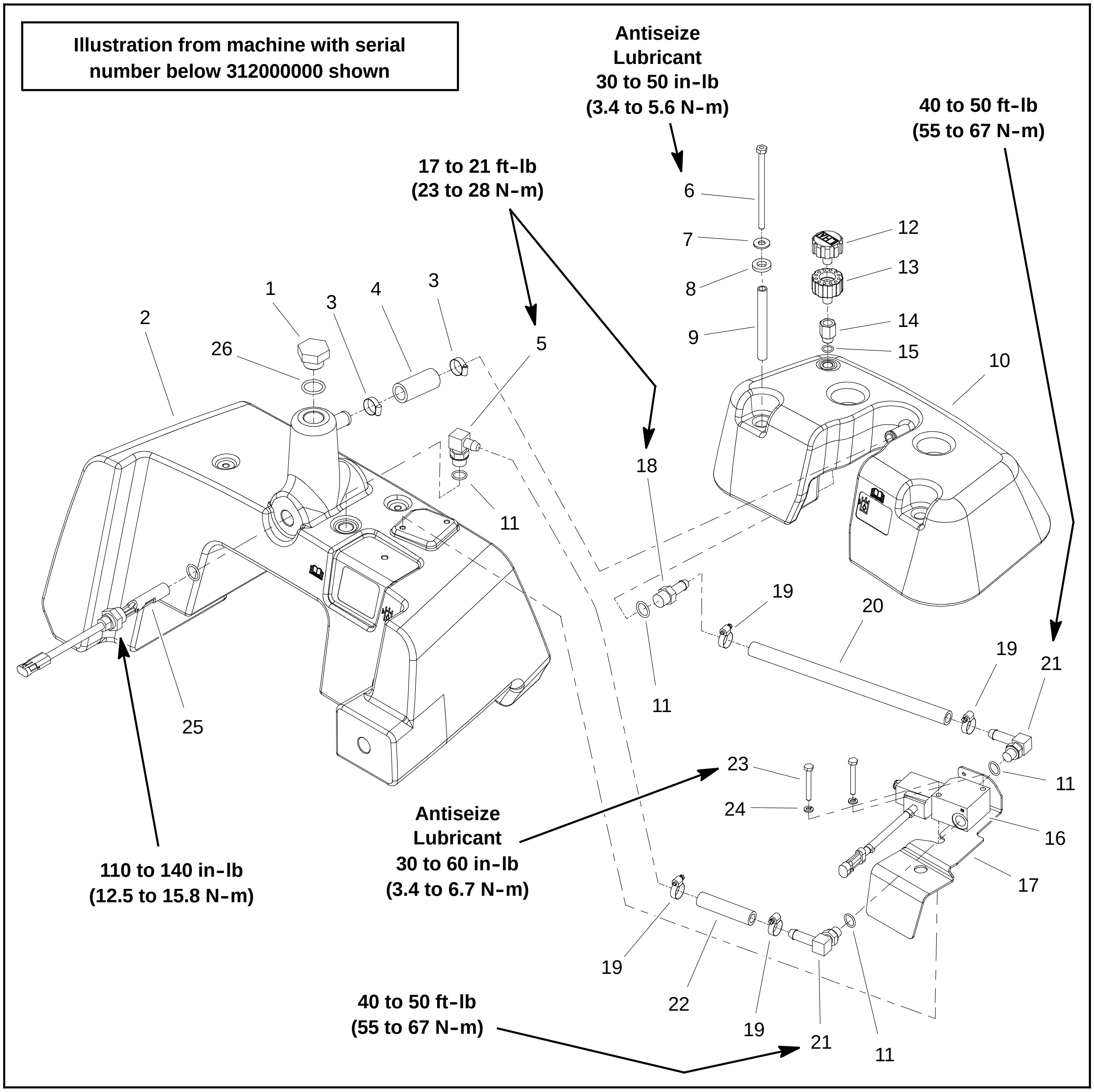
Illustration from machine with serial number below 312000000 shown
Antiseize Lubricant 30 to 50 in-lb (3.4 to 5.6 N-m)
40 to 50 ft-lb (55 to 67 N-m)
17 to 21 ft-lb (23 to 28 N-m)
6
7
8
9
12
13
14
15
10
1
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3
2
26
5
18
11
19
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19
21
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25
23
24
16
17
110 to 140 in-lb (12.5 to 15.8 N-m)
Antiseize Lubricant 30 to 60 in-lb (3.4 to 6.7 N-m)
19
22
19
21
11
40 to 50 ft-lb (55 to 67 N-m)

Figure 60

1. **Fitting**
2. **Hydraulic reservoir**
3. **Hose clamp (2 used)**
4. **Overflow hose**
5. **90° hydraulic fitting**
6. **Cap screw (4 used)**
7. **Flat washer (4 used)**
8. **Neoprene washer (4 used)**
9. **Spacer (4 used)**
10. **Leak detector tank**
11. **O-ring**
12. **Breather**
13. **Breather adapter**
14. **Hydraulic fitting**
15. **O-ring**
16. **Solenoid valve assembly**
17. **Cover**
18. **Straight barb fitting**
19. **Hose clamp (4 used)**
20. **Valve hose**
21. **90° barb fitting (2 used)**
22. **Tank hose**
23. **Cap screw (2 used)**
24. **Lock washer (2 used)**
25. **Oil level sensor**
26. **O-ring**

NOTE: The Turf Guardian^{TM} Leak Detector System is optional on Greensmaster TriFlex Hybrid machines.

NOTE: See Turf Guardian^{TM} Leak Detector System in Chapter 6 – Electrical System for leak detector operation information.

Removal (Fig. 60)

1. Park machine on a level surface, set brake, lower cutting units and stop engine. Remove key from the ignition switch.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

2. Place a clean container, large enough to collect two (2) gallons (7.6 liters), under the pump assembly to collect hydraulic oil.

3. Clamp gear pump inlet hose to control drainage from hydraulic reservoir (Fig. 61). Remove pump inlet hose from gear pump. Release clamp from hose and drain about two (2) gallons (7.6 liters) of oil from the reservoir.

4. Clamp pump inlet hose to prevent draining additional hydraulic oil from hydraulic reservoir.

5. Remove four (4) cap screws (item 6), flat washers (item 7), neoprene washers (item 8) and spacers (item 9) that secure leak detector tank to hydraulic reservoir.

6. Thoroughly clean junction of overflow hose (item 4) and leak detector tank barb. Loosen hose clamp (item 3) and disconnect overflow hose from tank barb.

7. Lift leak detector tank slightly and clean junction of valve hose (item 20) at solenoid valve fitting (item 21). Loosen hose clamp (item 19) and disconnect valve hose at solenoid valve fitting.

NOTE: On Greensmaster 3320 machines with serial number above 312000000, the fuel system carbon canister is attached to the leak detector tank (Fig. 62). See Fuel System Carbon Canister (Serial Number Above 312000000) in the Service and Repairs section of Chapter 3 – Gasoline for information on disconnecting the canister.

8. Remove leak detector tank assembly from machine.

9. If necessary, remove valve hose (item 20), hydraulic fitting (item 18) and breather assembly from leak detector tank. Discard all removed O–rings.

10. Clean leak detector tank and tank components with clean solvent. Inspect tank for leaks, cracks or other damage.

NOTE: If solenoid valve (item 16) removal is necessary, see Leak Detector Solenoid Valve Assembly in this section.

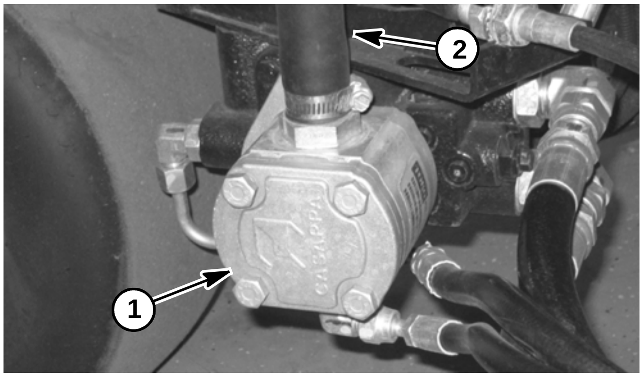

Figure 61

1. **Gear pump**
2. **Inlet hose**

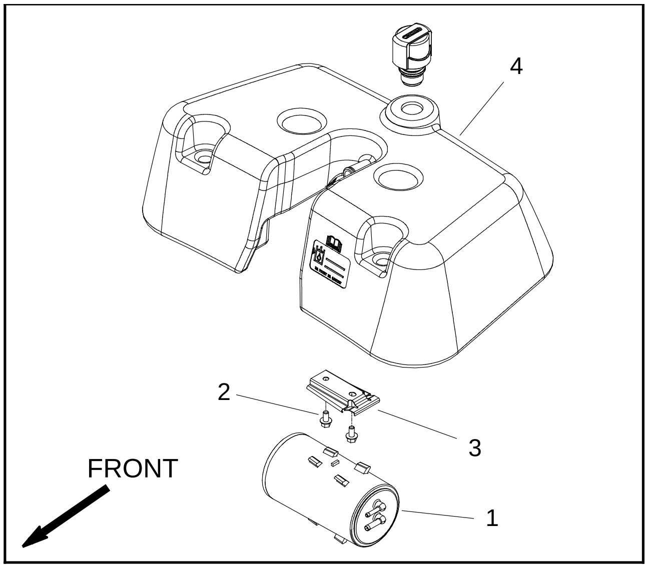

Figure 62

1. **Carbon cannister**
2. **Screw (2 used)**
3. **Cannister bracket**
4. **Leak detector tank**

Installation (Fig. 60)

1. If hydraulic fitting (item 18) and breather assembly were removed from leak detector tank, lubricate and place new O–rings onto fittings. Install components into tank openings. Tighten fitting (item 18) from **17 to 21 ft–lb (23 to 28 N–m)**.

2. Connect valve hose (item 20) to tank fitting (item 18) and secure with hose clamp (item 19).

NOTE: On Greensmaster 3320 machines with serial number above 312000000, see Fuel System Carbon Canister (Serial Number Above 312000000) in the Service and Repairs section of Chapter 3 – Gasoline for information on connecting the fuel system carbon canister.

3. Position leak detector tank assembly over hydraulic reservoir and connect valve hose (item 20) to solenoid valve fitting (item 21). Secure hose with hose clamp (item 19).

4. Connect overflow hose (item 4) to leak detector tank barb and secure with hose clamp (item 3).

5. Apply antiseize lubricant to the end threads of the four (4) cap screws (item 6) used to secure leak detector tank to hydraulic reservoir.

IMPORTANT: Do not over-tighten cap screws when securing leak detector tank to hydraulic reservoir. Threads in reservoir may become damaged.

6. Secure leak detector tank to hydraulic reservoir with four spacers (item 9), neoprene washers (item 8), flat washers (item 7) and cap screws (item 6). Torque cap screws from **30 to 50 in-lb (3.4 to 5.6 N-m)**.

NOTE: Monitor hydraulic fluid level in leak detector tank window. As air is removed from the hydraulic circuit, additional oil may have to be added to reservoir.

7. Remove cap from main hydraulic reservoir and slowly fill to cold fill level mark next to sight window on leak detector tank.

8. Verify leak detector operation.

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Leak Detector Solenoid Valve Assembly (Machines Equipped with Optional Turf GuardianTM Leak Detector System)

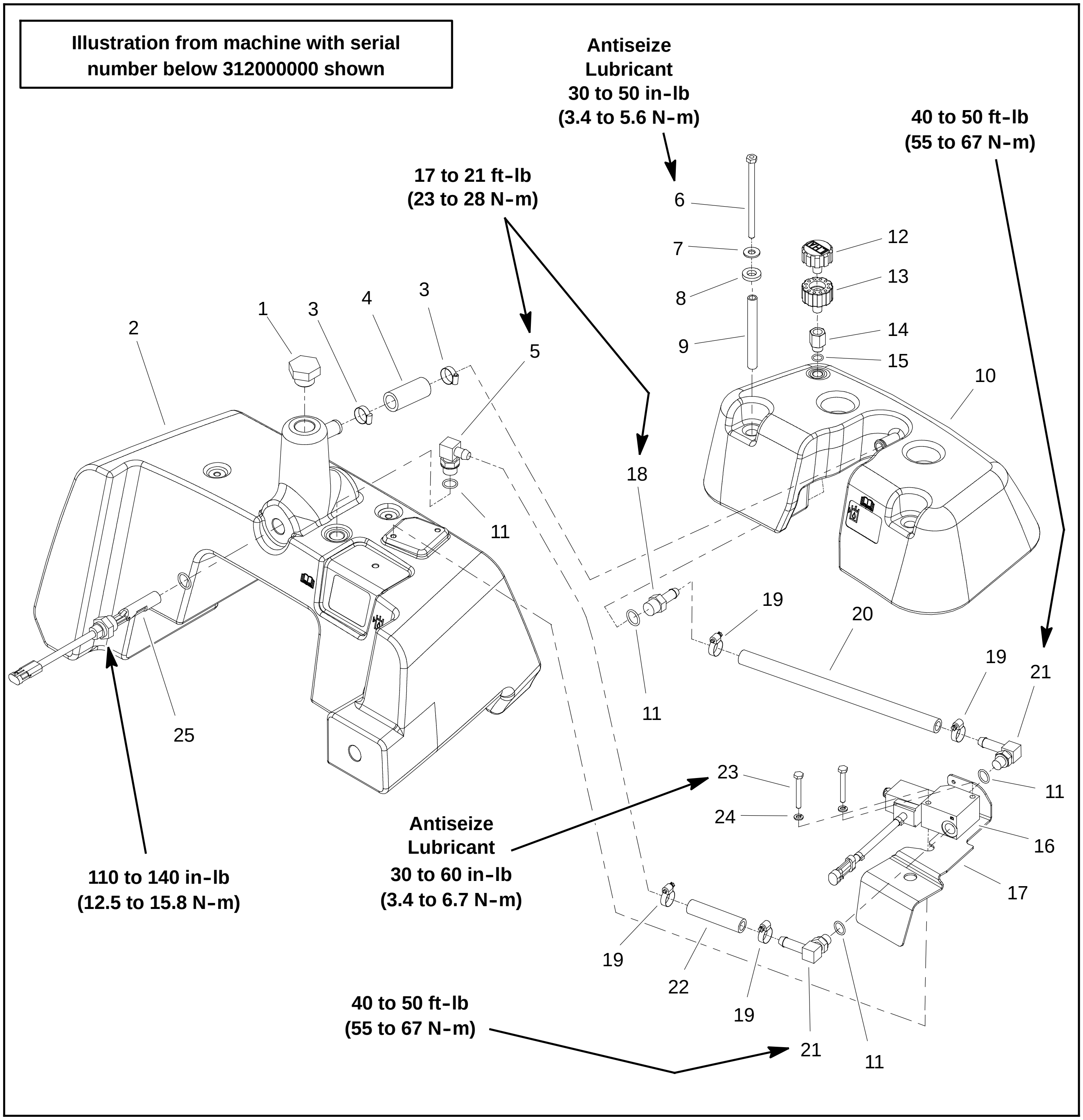
Illustration from machine with serial number below 312000000 shown
Antiseize Lubricant
30 to 50 in-lb
(3.4 to 5.6 N-m)
40 to 50 ft-lb
(55 to 67 N-m)
17 to 21 ft-lb
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Antiseize Lubricant
30 to 60 in-lb
(3.4 to 6.7 N-m)
110 to 140 in-lb
(12.5 to 15.8 N-m)
19
22
19
21
11
40 to 50 ft-lb
(55 to 67 N-m)

Figure 63

1. Fitting
2. Hydraulic reservoir
3. Hose clamp (2 used)
4. Overflow hose
5. 90° hydraulic fitting
6. Cap screw (4 used)
7. Flat washer (4 used)
8. Neoprene washer (4 used)
9. Spacer (4 used)
10. Leak detector tank
11. O-ring
12. Breather
13. Breather adapter
14. Hydraulic fitting
15. O-ring
16. Solenoid valve assembly
17. Cover
18. Straight barb fitting
19. Hose clamp (4 used)
20. Valve hose
21. 90° barb fitting (2 used)
22. Tank hose
23. Cap screw (2 used)
24. Lock washer (2 used)
25. Oil level sensor

NOTE: The Turf Guardian^{TM} Leak Detector System is optional on Greensmaster TriFlex Hybrid machines.

Removal (Fig. 63)

1. Park machine on a level surface, set brake, lower cutting units and stop engine. Remove key from the ignition switch.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in this section.

2. Remove leak detector tank (see Leak Detector Tank in this section).

3. Clean junction of tank hose (item 22) at solenoid valve fitting (item 21). Loosen hose clamp (item 19) and disconnect tank hose at solenoid valve fitting.

4. Unplug machine wire harness connector from the solenoid valve connector.

5. Remove two (2) cap screws (item 23) and lock washers (item 24) that secure solenoid valve assembly to hydraulic reservoir.

6. Remove solenoid valve assembly from machine.

7. If necessary, remove fittings from solenoid valve manifold. Discard removed O-rings.

Manifold Service

1. Disassemble solenoid valve manifold as needed using Figure 64 as a guide.

2. For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this section.

   A. When installing cartridge valve, torque valve **35 ft-lb (47 N-m)**.

   B. When installing solenoid coil, apply a drop of Loctite #242 (or equivalent) to threads of valve and torque nut **10 in-lb (1.1 N-m)**.

Installation (Fig. 63)

1. If fittings were removed from solenoid valve manifold, lubricate and place new O-rings onto fittings. Install fittings into manifold openings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter). Torque fittings from **40 to 50 ft-lb (55 to 67 N-m)**.

2. Position cover (item 17) and solenoid valve assembly to hydraulic reservoir. Orientate the solenoid valve assembly so the solenoid coil is closer to the front of the reservoir.

3. Apply antiseize lubricant to the end threads of the two (2) cap screws used to secure solenoid valve assembly to hydraulic reservoir.

4. Secure solenoid valve assembly to hydraulic reservoir with two (2) cap screws (item 23) and lock washers (item 24). Torque cap screws from **30 to 60 in-lb (3.4 to 6.7 N-m)**.

5. Connect tank hose (item 22) to solenoid valve fitting (item 21) and secure with hose clamp (item 19).

6. Install leak detector tank (see Leak Detector Tank in this section).

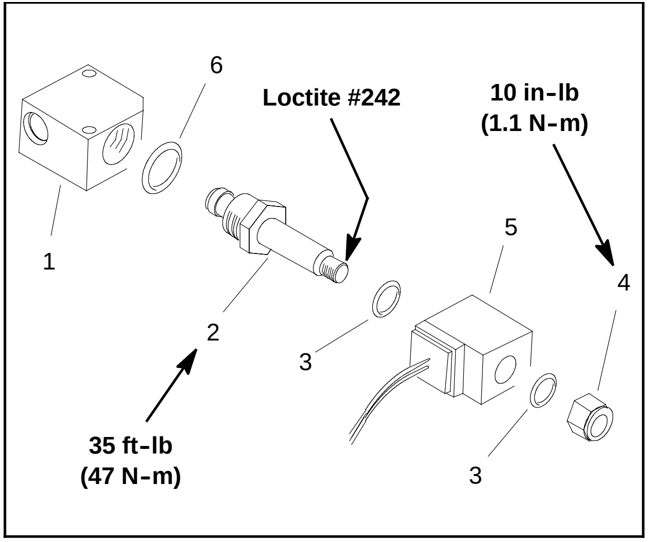

Figure 64

1. **Manifold**
2. **Cartridge valve**
3. **Seal**
4. **Nut**
5. **Solenoid coil**
6. **Cartridge seal**

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Chapter 6

Electrical System

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General Information

Operator’s Manual

The Operator’s Manual provides information regarding the operation, general maintenance and maintenance intervals for your Greensmaster machine. Refer to that publication for additional service information.

Toro Electronic Controller (TEC)

Greensmaster TriFlex Hybrid 3320 and 3420 machines use a Toro Electronic Controller (TEC) to manage 12 volt machine electrical functions. The controller is microprocessor controlled that senses the condition of various switches (inputs) and directs electrical power to control appropriate machine functions (outputs) based on the inputs. The status of inputs to the controller as well as outputs from the controller can be monitored with the Diagnostic Display (see Special Tools in this chapter).

IMPORTANT: Before performing any welding on the machine, disconnect the battery cables from the battery, disconnect the wire harness connector from the Toro Electronic Controller(s) and disconnect the terminal connector from the alternator. These steps will prevent damage to the machine electrical system.

CAN–bus Communications

System communication between electrical components on Greensmaster Hybrid TriFlex machines is accomplished on two (2) CAN–bus communication systems. The CAN–bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be reduced.

One of these CAN–bus systems allows TEC controller communication between machine 12 volt components (e.g. engine components, InfoCenter display). The second CAN–bus system provides necessary control for the electric cutting reels system (generator, cutting reel motors). An isolation module is included in the machine electrical system to allow communication between the two systems while maintaining ground isolation for the 48 volt system.

CAN identifies the Controller Area Networks that is used on the Greensmaster. Two (2) specially designed, twisted wires form the bus for both of the networks used on the Hybrid machines. These wires provide the data pathways between machine components. The engineering term for these two (2) wires are CAN–high and CAN–low. At the ends of the twisted pair of bus wires are 120 ohm termination resistors.

Each of the components that is controlled by the CAN–bus link only needs four (4) wires to operate and communicate to the system: CAN–high, CAN–low, B+ (power) and ground.

IMPORTANT: The termination resistors at the ends of the bus wires are required for proper electrical system operation.

Opening Electrical Circuit to Cutting Units

CAUTION

Before installing, removing or servicing the cutting units, separate the cutting unit power disconnect. This will prevent unexpected cutting unit operation.

Before installing, removing or working on the cutting units, disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (Fig. 1). The couplers are located at the base of the rollover bar on the left side of the traction unit. Connect the couplers together before operating the machine.

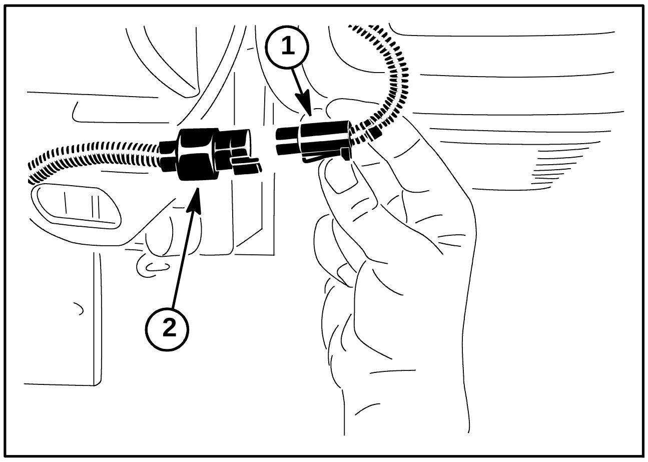

Figure 1

1. **Coupler**
2. **Stationary coupler**

Electrical Drawings

The electrical schematic and wire harness drawings for Greensmaster TriFlex Hybrid 3320 and 3420 machines are located in Chapter 10 – Foldout Drawings.

Electrical System Operation

Greensmaster TriFlex Hybrid machines use two (2) separate electrical systems. Most machine functions operate on a typical 12 volt DC system. The second system exists to operate the electric cutting reels and is a 48 volt DC electrical system. Basic information about the two systems is included below.

12 Volt DC System Operation

Engine electrical components, machine operation switches, hydraulic solenoid coils and the machine TEC electronic controller are all included in the 12 volt system on Greensmaster TriFlex Hybrid machines. A 12 volt battery on the left side of the machine provides system electrical power. Circuit protection for the 12 volt system includes two (2) fuse blocks and several fusible links.

Information about electrical components in the 12 volt system is included in the Component Testing section of this chapter.

Electric Reel Drive System (48 Volt DC) Operation

Greensmaster TriFlex Hybrid machines utilize an engine driven generator to supply 48 volt DC electrical power to a set of three (3) electric motors that drive the cutting reels. The 48 volt system includes the engine driven generator assembly, the three (3) cutting reel motors, a 48 volt battery pack, the main contactor and control modules. Circuit protection for the 48 volt system includes two (2) fuses.

The generator is a 48 VDC, 5400 watt, air cooled, brushless, permanent magnet device. The generator has its own integral invertor and on–board controller. The machine TEC controller provides generator direction with communication via the CAN–bus system.

The three (3) cutting reel motors are identical 48 VDC, 1100 watt, brushless, permanent magnet motors. Each motor has its own integral invertor and on–board controller. The machine TEC controller interfaces the reel motor via the CAN–bus system.

The battery pack is composed of four (4) 12 volt sealed batteries connected in series to achieve the necessary 48 VDC. The batteries are included in the system to ensure that reels come up to speed quickly when initially engaged. The batteries are also used as a buffer when the cutting reels are shut off. As the cutting reels slow to a stop, they generate electrical power that is absorbed by the battery pack. The batteries also assist with system precharge and diagnostics.

The main contactor exists in the electric reel drive system to connect the battery pack with the generator and reel motor controllers. The generator controller determines when the main contactor is engaged.

Control for the components in the electric reel drive system is handled by integral controllers in the generator and reel motors along with direction from the TEC machine controller via the CAN–bus system. Since the TEC controller (12 VDC component) sends and receives information with the generator and reel motors (48 VDC components), the CAN–bus circuit needs to communicate with both systems. The isolation module is included in the system to allow effective communication while keeping the two machine electrical systems isolated. Also, the location ID module exists to identify the location of the three (3) cutting reel motors. This allows such machine features as raising the center cutting unit slightly later than the front cutting units.

The 48 volt system is an isolated system so the vehicle frame is not used for any ground connections in this system. A 48V battery disconnect is included on the machine which can be used to disconnect the cutting unit motors from the electrical power supply to prevent unexpected reel motor operation when performing service.

IMPORTANT: When connecting the battery pack in the 48 volt system, make sure that battery polarity is carefully checked. System damage can occur if batteries are not connected correctly.

Information about electrical components in the 48 volt system is included in the Component Testing section of this chapter.

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Turf Guardian™ Leak Detector System Operation (Optional Kit)

NOTE: The Turf Guardian^{TM} Leak Detector System is optional on Greensmaster TriFlex Hybrid machines.

Before Start-Up (Cold Oil)

With ignition switch OFF, solenoid valve is open. Before start-up, hydraulic fluid is at level mark of sight gauge (oil cold). Oil level sensor float is in raised position, keeping alarm circuit open.

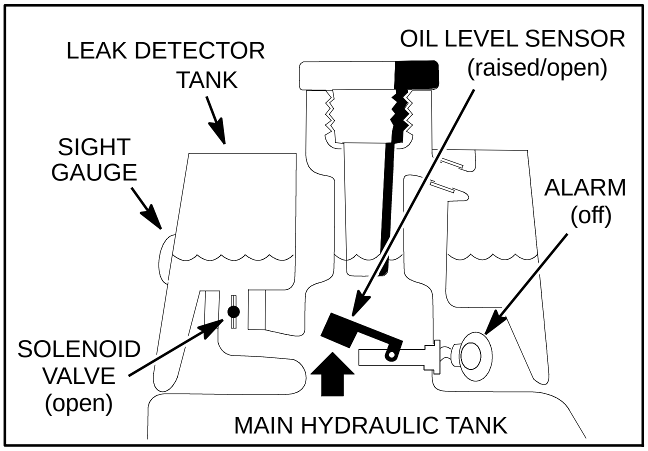

LEAK DETECTOR TANK
OIL LEVEL SENSOR (raised/open)
SIGHT GAUGE
ALARM (off)
SOLENOID VALVE (open)
MAIN HYDRAULIC TANK

Figure 2

Normal Operation (Warm Oil)

When ignition switch is turned ON, solenoid valve closes. During normal operation, hydraulic fluid expands, causing it to overflow into leak detector tank. The oil level sensor stays in the raised position keeping alarm circuit open.

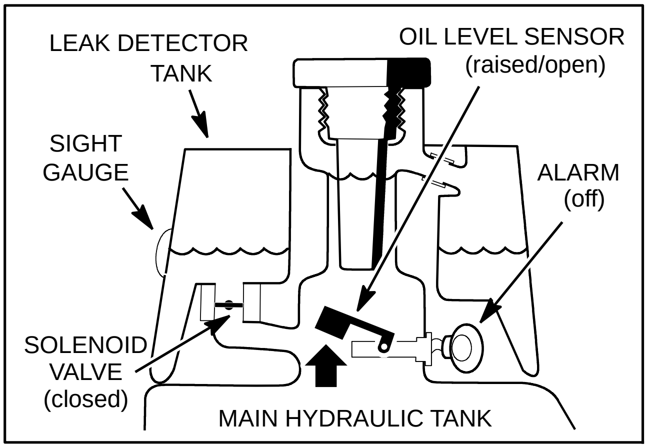

LEAK DETECTOR TANK
OIL LEVEL SENSOR (raised/open)
SIGHT GAUGE
ALARM (off)
SOLENOID VALVE (closed)
MAIN HYDRAULIC TANK

Figure 3

Leak Alert!

If hydraulic fluid leaks during operation, the fluid level in the main hydraulic tank drops. This causes the oil level sensor float to lower, closing the alarm circuit. The alarm will sound and the console indicator light will illuminate after a one (1) second time delay.

NOTE: During normal operation, with cutting units lowered, approximately 5 oz (148 ml) of hydraulic fluid will leak before the oil level sensor float closes the alarm circuit and activates the alarm.

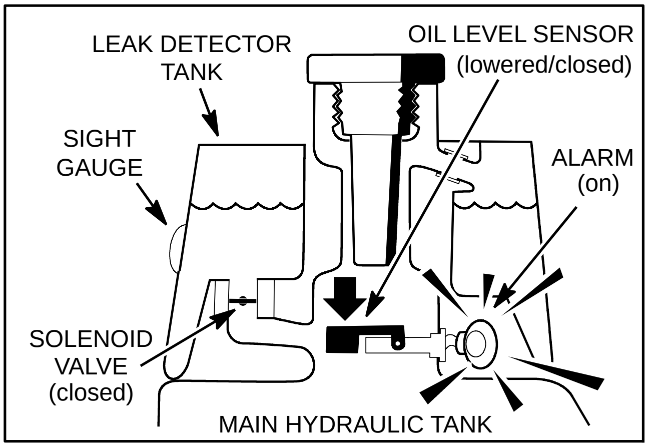

LEAK DETECTOR TANK
OIL LEVEL SENSOR (lowered/closed)
SIGHT GAUGE
ALARM (on)
SOLENOID VALVE (closed)
MAIN HYDRAULIC TANK

Figure 4

Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local supplier.

Multimeter

The meter can test electrical components and circuits for current, resistance or voltage. Obtain this tool locally.

NOTE: Toro recommends the use of a DIGITAL Volt–Ohm–Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

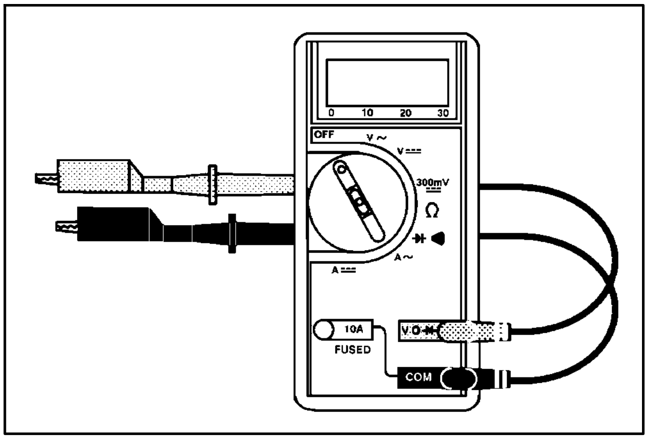

0 10 20 30
OFF
V ~
V ═
300mV
Ω
A ═
A ~
10A
FUSED
V·Ω·
COM

Figure 5

Hand Held Diagnostic Display

The Hand Held Diagnostic Display (Fig. 6) can be connected to the wiring harness communication connector located under the operator seat to verify correct electrical functions of the Toro Electronic Controller (TEC). TEC inputs and outputs can be checked using the Diagnostic Display.

Toro Part Number for Hand Held Diagnostic Display: **85–4750**

Toro Part Number for Greensmaster 3320/3420 Overlay (English)**: 115–8227**

NOTE: Diagnostic Display overlays are available in several languages for your Greensmaster. Refer to your Parts Catalog for overlay language options and part numbers.

IMPORTANT: The Hand Held Diagnostic Display must not be left connected to the machine. It is not designed to withstand the environment of the machine's every day use. When use of Diagnostic Display is completed, disconnect it from the machine and install protective cap to wire harness connector. Store Diagnostic Display in a dry, secure, indoor location and not on machine.

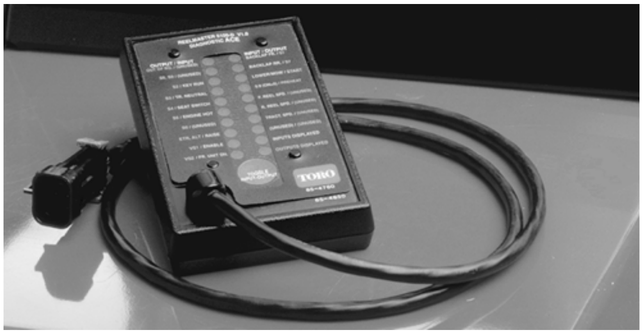
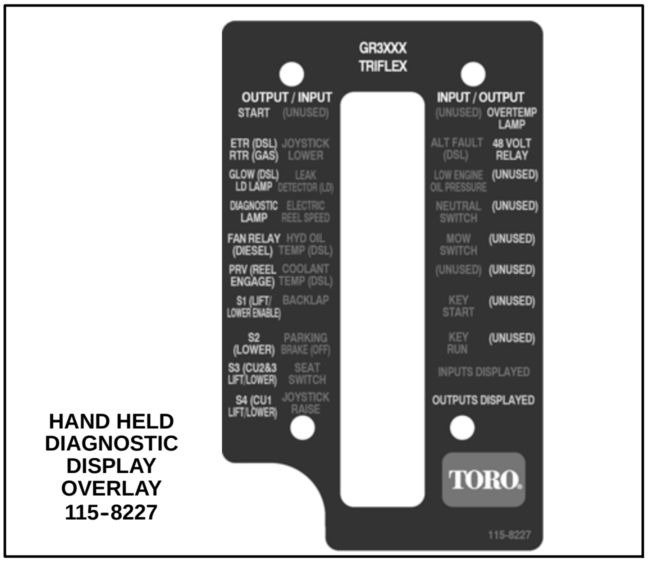


Figure 6


GR3XXX
TRIFLEX
OUTPUT / INPUT
START (UNUSED)
ETR (DSL) RTR (GAS) JOYSTICK LOWER
GLOW (DSL) LD LAMP LEAK DETECTOR (LD)
DIAGNOSTIC LAMP ELECTRIC REEL SPEED
FAN RELAY (DIESEL) HYD OIL TEMP (DSL)
PRV (REEL ENGAGE) COOLANT TEMP (DSL)
S1 (LIFT/ LOWER ENABLE) BACKLAP
S2 (LOWER) PARKING BRAKE (OFF)
S3 (CU2&3 LIFT/LOWER) SEAT SWITCH
S4 (CU1 LIFT/LOWER) JOYSTICK RAISE
INPUT / OUTPUT
(UNUSED) OVERTEMP LAMP
ALT FAULT (DSL) 48 VOLT RELAY
LOW ENGINE OIL PRESSURE (UNUSED)
NEUTRAL SWITCH (UNUSED)
MOW SWITCH (UNUSED)
(UNUSED) (UNUSED)
KEY START (UNUSED)
KEY RUN (UNUSED)
INPUTS DISPLAYED
OUTPUTS DISPLAYED
TORO
115-8227

HAND HELD DIAGNOSTIC DISPLAY OVERLAY 115–8227

Figure 7

Battery Terminal Protector

Aerosol spray that should be used on battery terminals, ring terminals and fork terminals to reduce corrosion problems. Apply terminal protector to the connection after the battery cable, ring terminal or fork terminal has been secured.

Toro Part Number: **107-0392**

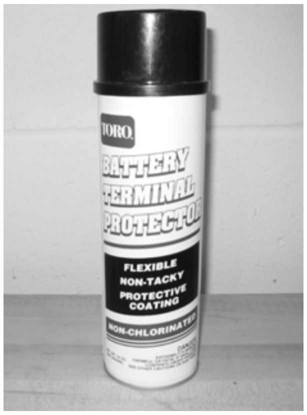

TORO
BATTERY
TERMINAL
PROTECTOR
FLEXIBLE
NON-TACKY
PROTECTIVE
COATING
NON-CHLORINATED

Figure 8

Dielectric Lubricant/Sealant

Dielectric gel should be used to prevent corrosion of unsealed connection terminals. To ensure complete coating of terminals, liberally apply gel to both component and wire harness connector, plug connector to component, unplug connector, reapply gel to both surfaces and reconnect harness connector to component. Connectors should be thoroughly packed with gel for effective results.

Do not use dielectric gel on sealed connection terminals as the gel can unseat connector seals during assembly.

Toro Part Number: **107-0342**

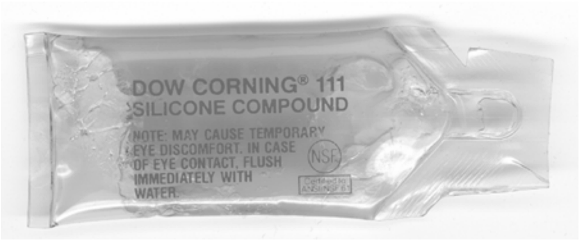

DOW CORNING® 111
SILICONE COMPOUND
NOTE: MAY CAUSE TEMPORARY EYE DISCOMFORT. IN CASE OF EYE CONTACT, FLUSH IMMEDIATELY WITH WATER.
NSF

Figure 9

Battery Hydrometer

Use the Battery Hydrometer when measuring specific gravity of battery electrolyte. Obtain this tool locally.

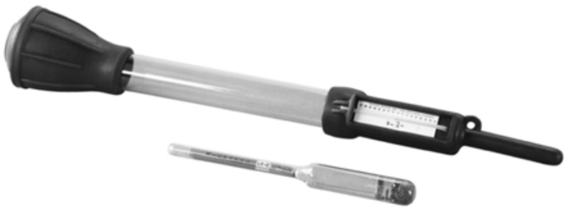


Figure 10

Generator Rotor Tool Set

The generator rotor tool set is required to remove and install the rotor from the generator housing. Tool set includes base plate, threaded shaft and handle (Fig. 12).

Toro Part Number: **TOR6029**

NOTE: For generator service procedures, see Generator Assembly Service in the Service and Repairs section of this chapter.

Generator Rotor Removal

1. Remove screws that secure generator cover. Do not remove cover from generator assembly.

2. Secure tool set base plate to generator housing with three (3) 3/8” – 16 X 3” cap screws.

IMPORTANT: To prevent damage to generator rotor shaft threads, position a thick washer or spacer on the end of the shaft when using tool set.

3. Position thick washer or spacer on the end of the generator rotor shaft. Install threaded shaft into base plate and against washer or spacer on rotor shaft.

IMPORTANT: The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during removal. Be cautious during rotor removal to prevent component damage or personal injury.

4. Turn threaded shaft with handle to remove generator rotor and cover from generator housing. Support rotor to prevent it from falling during removal.

5. Leave threaded shaft installed in same position in base plate for rotor installation purposes.

Generator Rotor Installation

1. Secure tool set base plate to generator housing with three (3) 3/8” – 16 X 3” cap screws.

2. Make sure that threaded shaft is installed into base plate so that the end of the threaded shaft prevents the rotor body from entering the generator housing.

IMPORTANT: The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during installation. Be cautious during rotor installation to prevent component damage or personal injury.

3. While guiding rotor into generator housing, slowly rotate threaded shaft to allow the rotor to be drawn into the housing. Once rotor is fully installed into housing, remove tool set from generator housing.

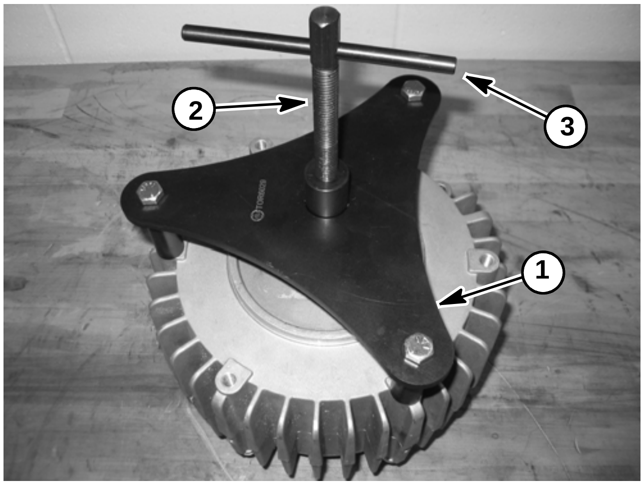


Figure 12

1. Base plate
2. Threaded shaft
3. Handle

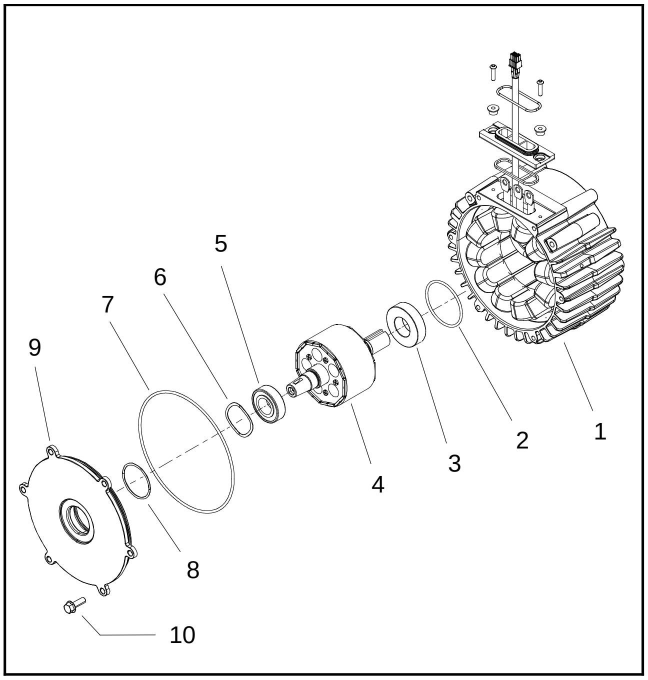


Figure 13

1. Housing/stator assembly
2. O-ring
3. Bearing
4. Rotor assembly
5. Bearing
6. Wave washer
7. O-ring
8. O-ring
9. Cover
10. Flange screw (6 used)

Cutting Reel Motor Rotor Tool Set

The rotor tool set for the cutting reel motor is required to remove and install the rotor from the reel motor housing. Tool set includes base plate, threaded shaft and handle (Fig. 14).

Toro Part Number: **TOR6028**

NOTE: For cutting reel motor service procedures, see Cutting Reel Motor Service in the Service and Repairs section of this chapter.

Cutting Reel Motor Rotor Removal

1. Remove gearbox cover and output gear from motor assembly (see Cutting Reel Motor Service in the Service and Repairs section of this chapter).

2. Remove screws that secure motor cover. Do not remove cover from motor assembly.

3. Secure tool set base plate to motor housing with four (4) of the cover screws.

4. Install threaded shaft into base plate.

IMPORTANT: The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during removal. Be cautious during rotor removal to prevent component damage or personal injury.

5. Turn threaded shaft with handle to remove rotor and motor cover from motor housing. Support rotor to prevent it from falling from housing during removal.

6. Leave threaded shaft installed in same position in base plate for rotor installation purposes.

Cutting Reel Motor Rotor Installation

1. Secure tool set base plate to motor housing with four (4) of the cover screws.

2. Make sure that threaded shaft is installed into base plate so that the end of the threaded shaft prevents the rotor body from entering the motor housing.

IMPORTANT: The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during installation. Be cautious during rotor installation to prevent component damage or personal injury.

3. While guiding rotor into motor housing, slowly rotate threaded shaft to allow the rotor to be drawn into the housing. Once rotor is fully installed into housing, remove tool set from motor housing.

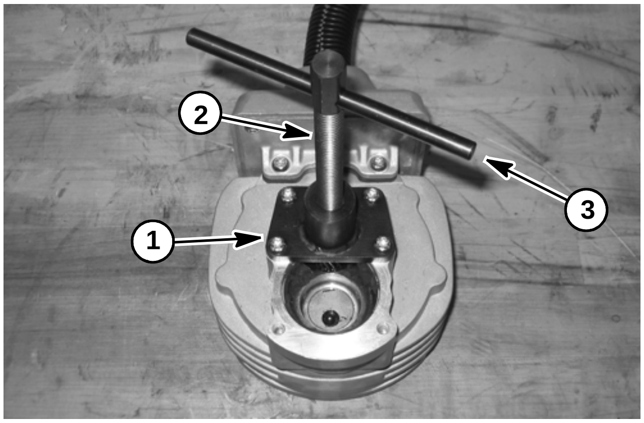


Figure 14

1. Base plate	**3. Handle**
2. Threaded shaft	

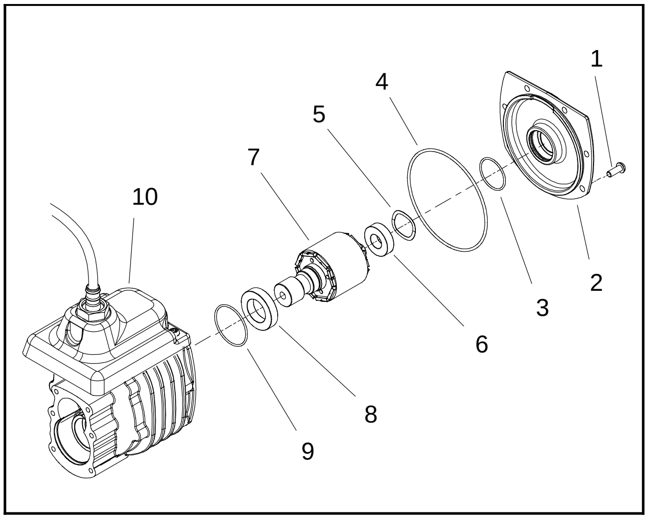


Figure 15

1. Screw (6 used)	**6. Bearing**
2. Motor cover	**7. Rotor**
3. O-ring	**8. Bearing**
4. O-ring	**9. O-ring**
5. Wave washer	**10. Housing assembly**

InfoCenter Display (Serial Number Above 312000000)

The InfoCenter Display used on TriFlex Hybrid Greensmowers with serial number above 312000000 is a LCD device that is located on the console. The InfoCenter provides information for the machine operator during machine operation, provides electrical system diagnostic assistance for technicians and allows inputs for adjustable machine settings.

Power for the InfoCenter is available when energized by the TEC controller (key switch in the START or RUN position). A CAN–bus system involving the TEC controller, the generator, the cutting unit motors and the InfoCenter is used to provide necessary machine communication for InfoCenter operation.

Splash Screen

The InfoCenter splash screen (Fig. 16) is displayed when the key switch is initially turned to the RUN or START position. The splash screen allows basic machine information to be reviewed. After the splash screen has been on the InfoCenter for several seconds, the main information screen will be displayed on the InfoCenter.

The splash screen can be used to identify hour meter reading, machine battery voltage, generator voltage and engine status. If the fault log indicator is displayed on the splash screen, a list of electrical faults that have occurred is available on the faults screen. Accessing the fault log is described below in Faults Screen.

The main menu and additional information screens can be accessed from the InfoCenter splash screen by pressing and releasing the menu/back button (left button) on the display. Information on the main menu and menu item screens is included below.

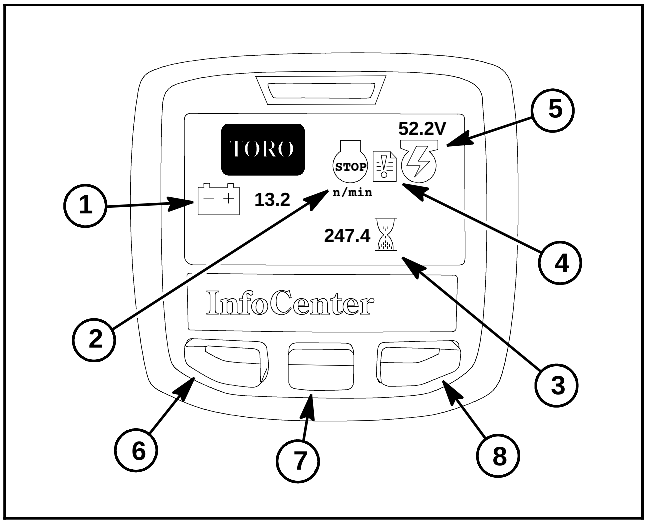


Figure 16

1. **Battery voltage**
2. **Engine RPM/status**
3. **Hour meter**
4. **Fault log indicator**
5. **Generator voltage/status**
6. **Menu/back button**
7. **Down button**
8. **Right button**

Main Information Screen

The InfoCenter main information screen (Fig. 17) is displayed after the initial splash screen has been displayed for several seconds. During normal machine operation, the main information screen provides machine information for the operator.

The main information screen can be used to monitor engine coolant temperature, engine RPM, generator voltage, PTO speed and hour meter reading. The screen will also identify if the parking brake is applied.

The position of the functional control lever on the console will be identified on the main information screen as follows:

- The letter **N** will be displayed on the InfoCenter when the functional control lever is in the neutral position.
- The **rabbit icon** will be displayed on the InfoCenter when the functional control lever is in the transport position.
- The **turtle icon** will be displayed on the InfoCenter when the functional control lever is in the mow position.

The main information screen will include three (3) arrows to the right of the coolant temperature whenever the cutting units are either raising (up arrows) or lowering (down arrows).

If an electrical machine fault occurs during machine operation, the InfoCenter fault indicator will blink to notify the operator. Also, the fault log indicator on the InfoCenter screen will be displayed to notify the operator that recent machine faults have occurred. Accessing the fault log is described below in Faults Screen.

The main menu and additional information screens can be accessed from the InfoCenter main information screen by pressing and releasing the menu/back button (left button) on the display. Information on the main menu and menu item screens is included below.

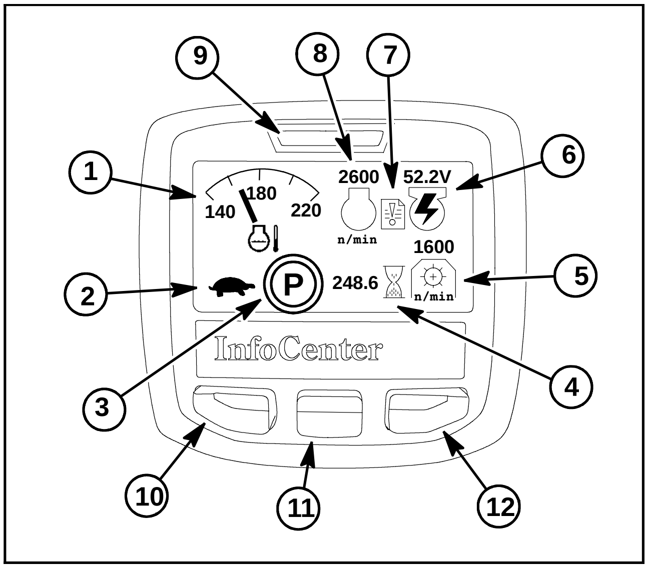


Figure 17

1. **Coolant temperature**
2. **Functional control status**
3. **Parking brake applied**
4. **Hour meter**
5. **PTO speed**
6. **Generator voltage/status**
7. **Fault log indicator**
8. **Engine RPM/status**
9. **Fault indicator**
10. **Menu/back button**
11. **Down button**
12. **Right button**

Main Menu Screen

The main menu screen can be accessed from the InfoCenter main information or splash screen by pressing and releasing the menu/back button (left button) on the display. Once to the main menu screen (Fig. 18), navigation to the five (5) different menu items can occur. Pressing the move to menu item button (center button) allows a different menu item to be highlighted. Selection of the highlighted item is completed by pressing the choose item button (right button).

The main menu items include faults, service, diagnostics, settings and about. These menu items are described below.

To return to the main information screen from the main menu screen, press the back button (left button).

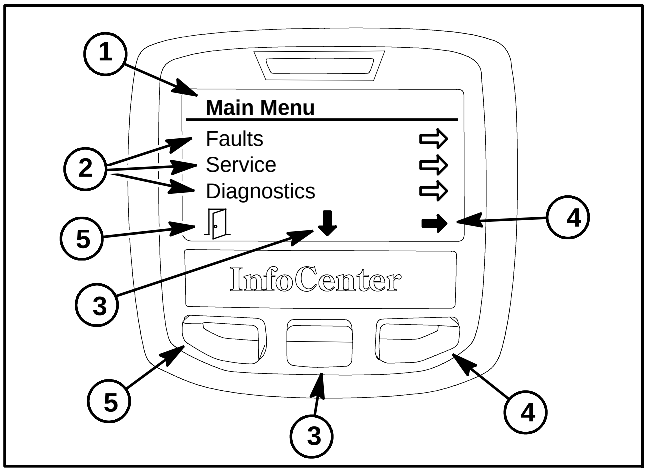


Figure 18

1. **Main menu**
2. **Menu items**
3. **Move to menu items**
4. **Choose menu item**
5. **Back button**

Faults Screen

The faults screen (Fig. 19) will list all machine electrical faults that have occurred since the faults were last cleared from the InfoCenter. The faults will be identified by a fault number and when the fault occurred. Faults that might occur on the machine are listed in Fault Codes in the Troubleshooting section of this chapter.

The InfoCenter fault log can be cleared by selecting the clear system faults menu item. The cleared faults will be removed from the InfoCenter but will be retained in the TEC controller memory.

If a fault occurs during machine use, there may be a change in machine functionality due to the fault. Should there be machine operation issues due to a fault, a first step to remedy the issue would be to disengage the cutting units, release the traction pedal, turn the key switch OFF and allow all machine functions to stop. Then, attempt to restart the machine to see if operation has returned to normal. Some faults will be reset during the restart and will then allow normal function. If a fault continues to occur, further system evaluation and possible component repair or replacement will be necessary.

To return to the main menu screen from the faults screen, press the back button (left button).

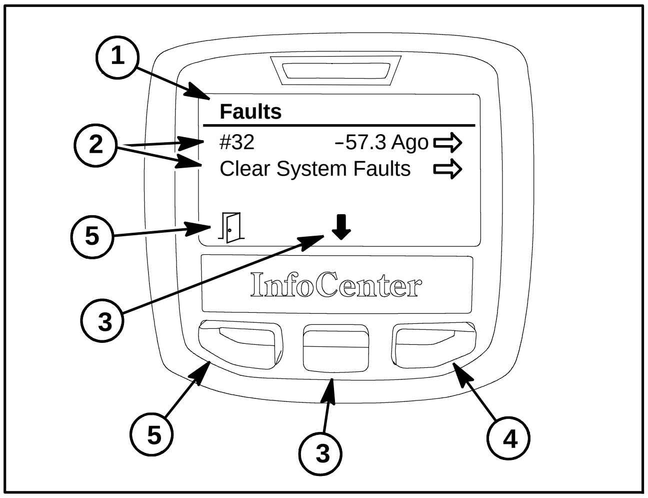


Figure 19

1. **Fault menu**
2. **Fault items**
3. **Move to menu items**
4. **Choose menu item**
5. **Back button**

Service Screen

The service screen (Fig. 20) contains machine operational information including hours and counts. Values listed for service menu items cannot be changed.

The options listed for hours include the following:

- **Key On** identifies the number of hours that the key switch has been in the RUN position.
- **Engine Run** identifies the number of hours that the engine has been running.
- **Transport** identifies the number of hours that the machine has been operated in transport speed.
- **Mow** identifies the number of hours that the machine has been operated with the cutting units engaged.
- **Backlap** identifies the number of hours that the machine has been operated with the cutting units engaged in the backlap position.
- **Fan On** identifies the number of hours that the machine has been operated with engine cooling fan engaged.
- **Over Temp** identifies the number of hours that the engine has been operated with an excessive temperature.

The options listed for counts include the following:

- **Preheats** identifies the number of times that the engine glow plugs have been energized.
- **Starts** identifies the number of times that the engine has been started.

To return to the main menu screen from the service screen, press the back button (left button).

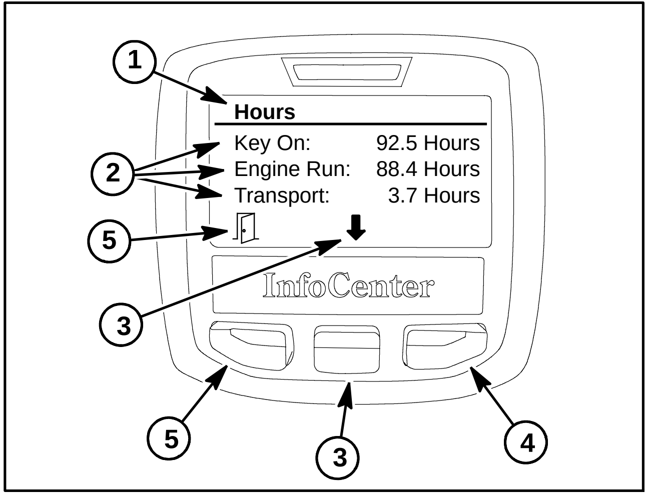


Figure 20

1. **Service menu**
2. **Service items**
3. **Move to menu items**
4. **Choose menu item**
5. **Back button**

Diagnostics Screen

The diagnostics screen (Fig. 21) lists the various states of machine electrical components. The diagnostics screen should be used to check operation of machine switches and controls.

For each of the diagnostics screen items, inputs, qualifiers and outputs are identified.

The diagnostics screen includes the following:

- **Engine Run** identifies machine requirements to allow the engine to run. Inputs indicate the state of the ignition switch. Qualifiers include the joystick position, functional control lever position, seat switch and parking brake position. Outputs consist of OK Run and RTR (Greensmaster 3320 relay to run) / ETR (Greensmaster 3420 energize to run).

- **Glowplugs** identifies machine requirements to allow the diesel engine glowplugs to be energized. Inputs indicate the state of the ignition switch. Outputs indicate whether the glowplugs are energized.

- **Fan** identifies machine requirements to allow the cooling fan to be energized on Greensmaster 3420 machines. Inputs indicate the state of the engine coolant and hydraulic oil (optional) temperature senders. Outputs indicate whether the fan is energized.

- **S1** identifies machine requirements to allow hydraulic lift control manifold solenoid coil S1 (raise/lower enable) to be energized. Inputs indicate the state of the joystick raise and lower switches. Qualifiers lists the joystick position. Outputs indicate whether solenoid S1 is energized.

- **S2** identifies machine requirements to allow hydraulic lift control manifold solenoid coil S2 (lower) to be energized. Inputs indicate the state of the joystick lower switch. Qualifiers identify the three (3) second timeframe to lower the cutting units. Outputs indicate whether solenoid S2 is energized.

- **S3** identifies machine requirements to allow hydraulic lift control manifold solenoid coil S3 (raise or lower) to be energized. Inputs indicate the state of the joystick raise and lower switches. Qualifiers identify the three (3) second timeframe plus the delay for the center cutting unit to raise or lower the cutting units. Outputs indicate whether solenoid S3 is energized.

- **S4** identifies machine requirements to allow hydraulic lift control manifold solenoid coil S2 (raise or lower) to be energized. Inputs indicate the state of the joystick raise and lower switches. Qualifiers identify the three (3) second timeframe plus the delay for the center cutting unit to raise or lower the cutting units. Outputs indicate whether solenoid S4 is energized.

- **Reels Enable** identifies whether the TEC output exists to energize the e–reels enable relay. This relay provides 48V logic power to the reel motors and generator.

To return to the main menu screen from the diagnostics screen, press the back button (left button).

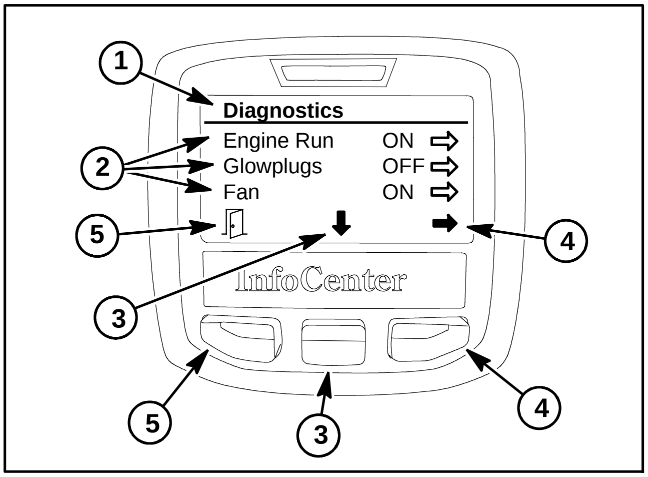


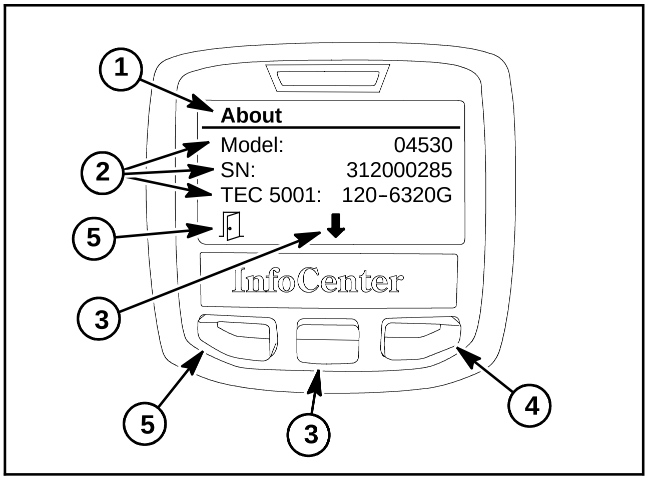
Figure 21

1. **Diagnostics menu**
2. **Diagnostics items**
3. **Move to menu items**
4. **Choose menu item**
5. **Back button**

About Screen

The about screen (Fig. 22) identifies the machine model number, serial number and software revisions for the TEC controller, InfoCenter, reel motor controllers and generator controller. The about screen also lists the CAN-bus status.

To return to the main menu screen from the about screen, press the back button (left button).



About
Model: 04530
SN: 312000285
TEC 5001: 120-6320G

Figure 22

1. **About menu**
2. **About items**
3. **Move to menu items**
4. **Choose menu item**
5. **Back button**

Settings Screen

The settings screen identifies the InfoCenter language and units (English or Metric). The settings screen also allows the operator to customize the backlight (brightness) and contrast settings for the InfoCenter display.

If either the backlight or contrast items are selected, the center button (–) or right button (+) can be used to change the display settings.

Protected menus allows the chosen PIN to be entered so that hidden settings for raise delay, lower delay, tapoff time, reel speed and backlap RPM can be viewed and adjusted as needed.

Protect settings allows the settings for raise delay, lower delay, tapoff time, reel speed and backlap RPM to be hidden so they cannot be changed. If the protect settings is ON, these settings will not be seen when using the InfoCenter until the protected menus is selected and the chosen PIN is entered. If protect settings is OFF (default setting), settings for these functions will be visible on the InfoCenter and can be adjusted by the operator.

NOTE: If the PIN is forgotten, a temporary PIN can be obtained from your Toro distributor.

Reset Defaults restores factory default settings for units, backlight and contrast. Also, reset defaults will restore the factory settings for raise delay, lower delay, tapoff time, reel speed and backlap RPM unless settings have been protected.

Raise delay allows the adjustment of the delay of the center cutting unit when the cutting units are raised by the operator. The factory default setting for the raise delay is 6 which is optimized for a 3.8 MPH mow speed.

Lower delay allows the adjustment of the delay of the center cutting unit when the cutting units are lowered by the operator. The factory default setting for the lower delay is 6 which is optimized for a 3.8 MPH mow speed.

Tapoff time allows the cutting units to be turned off without raising. The tapoff time represents the maximum time that the joystick can be held in raise without raising the cutting units. The factory default for the tapoff time is 1 which disables the feature.

Reel speed can be set based on cutting unit height of cut adjustment and expected ground speed. Refer to chart in Operator's Manual for reel speed recommendations.

Backlap RPM allows the backlap speed to be adjusted.

To return to the main menu screen from the settings screen, press the back button (left button).

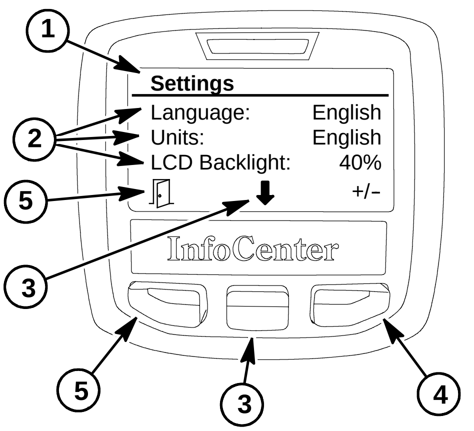


Figure 23

1. **Settings menu**
2. **Settings items**
3. **Move to menu items**
4. **Change menu item**
5. **Back button**

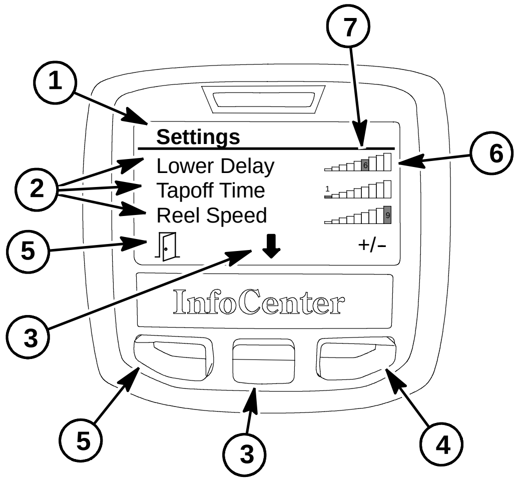


Figure 24

1. **Settings menu**
2. **Settings items**
3. **Move to menu items**
4. **Change menu item**
5. **Back button**
6. **Setting choices**
7. **Current setting**

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Troubleshooting

CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, there must be a good understanding of the electrical circuits and components used on this machine (see Chapter 10 – Foldout Drawings).

If the machine has any interlock switches by–passed, they must be reconnected for proper troubleshooting and safety.

NOTE: Check Diagnostic Light (serial number below 312000000) or InfoCenter display (serial number above 312000000) for possible operator advisories or faults whenever diagnosing machine electrical problems.

Diagnostic Light (Serial Number Below 312000000)

Greensmaster TriFlex Hybrid machines with serial number below 312000000 are equipped with a diagnostic light that indicates if the machine electrical system is functioning correctly. The diagnostic light is located on the control panel (Fig. 25).

When the ignition switch is moved to the RUN position and the machine electrical system is functioning properly, the diagnostic light will be illuminated for approximately three (3) seconds and then will turn off. The light should remain off during normal machine operation.

If the machine TEC controller detects an electrical system malfunction (fault) during machine operation, the diagnostic light will flash rapidly. The light will stop flashing and will automatically reset when the ignition switch is turned to the OFF position. The fault, however, will be retained in controller memory and can be retrieved at a future time (see Retrieving Fault Codes below).

If the diagnostic light does not illuminate when the ignition switch is turned to the RUN position, possible causes are:

- The diagnostic light (or circuit wiring) is faulty.
- TEC controller fuses are faulty (see Fuses in the Component Testing section of this chapter).
- The TEC controller is faulty.

Check electrical connections, controller fuses and the diagnostic light to determine malfunction.

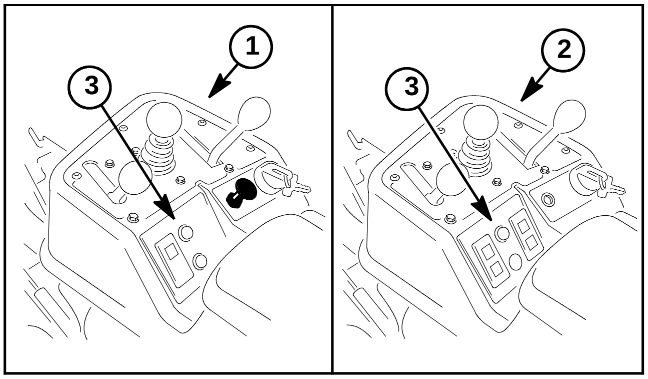

Figure 25

1. **Console (GR3320)**
2. **Console (GR3420)**
3. **Diagnostic light**

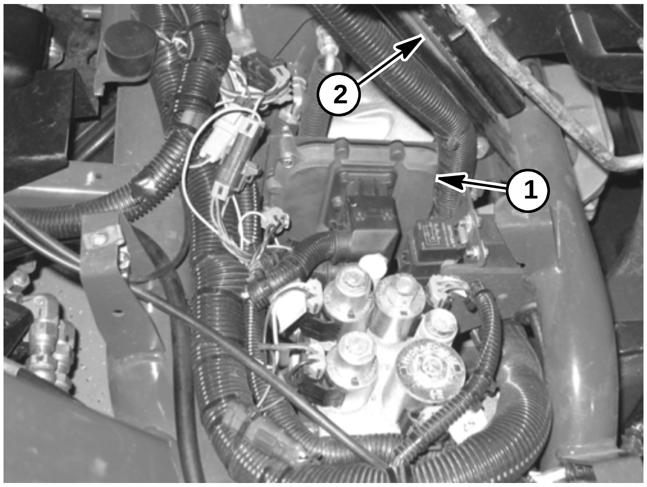

Figure 26

1. **TEC controller**
2. **Seat platform**

Retrieving Fault Codes

All machine fault codes are retained in the TEC controller memory. The three (3) most recent fault codes that have occurred within the last forty (40) hours of operation can be retrieved using the diagnostic light. To retrieve these fault codes from the controller memory, perform the following switch sequence:

1. Operator seat should be UNOCCUPIED.

2. Place functional control lever in the TRANSPORT position.

3. Make sure that backlap switch is in the MOW position.

4. Move and hold joystick in the RAISE position.

5. Turn ignition switch to the RUN position.

6. Monitor the diagnostic light for fault code(s).

NOTE: Once the diagnostic light begins to display fault codes, the joystick can be released.

Fault codes displayed by the diagnostic light consist of two (2) numbers. The first number is from one (1) to twelve (12) and the second number is from one (1) to nine (9). There will be a one (1) second pause between the first and second number of a code. Up to three (3) fault codes retained in controller memory will be displayed by the diagnostic light in order from the most recent fault to the oldest fault. If there are multiple faults in controller memory, there will be a three (3) second pause between codes. The fault codes will continually repeat after a five (5) second pause until the ignition key is turned off. See Fault Codes in this section to identify faults that have occurred with a machine.

If there are no faults that have occurred within the last forty (40) hours of operation, the diagnostic light will flash continuously after performing the above fault retrieval switch sequence.

If a fault code is not retrieved from the controller memory within forty (40) hours of machine operating time, the fault cannot be retrieved from controller memory using this procedure. If necessary, contact your Toro distributor to retrieve older fault codes.

Clearing Fault Codes

After the three (3) most recent fault codes have been retrieved, clearing of those faults can be completed using the following switch sequence:

1. Place machine switches in fault retrieval mode (see above). The diagnostic light should be displaying the fault codes.

2. Operator seat should remain UNOCCUPIED.

3. Move backlap switch to the BACKLAP position.

4. Move joystick to the RAISE position.

5. Monitor the diagnostic light for continuous flashing indicating that faults have been cleared from the controller memory.

Fault Codes

The list below identifies the fault codes that are generated by the TEC controller to identify an electrical system malfunction (fault) that occurred during machine operation. On machines with serial number below 312000000, the fault code will be retrieved using the diagnostic light (see Diagnostic Light (Serial Number Below 312000000) in this section). Use the InfoCenter Display for fault retrieval on machines with serial number above 312000000 (see InfoCenter Display (Serial Number Above 312000000) in this chapter).

Fault Code (Lamp Flashes)	Fault Description
1 – 1	The reel speed POT reading is out of range indicating either an open or short
1 – 2	Generator controller identified a fault associated with control of the 48V contactor
1 – 3	High Temp Warning – #1 cutting unit (allow machine to cool down) (Note: this fault IS NOT caused by a faulty sensor)
1 – 4	High Temp Warning – #2 cutting unit (allow machine to cool down) (Note: this fault IS NOT caused by a faulty sensor)
1 – 5	High Temp Warning – #3 cutting unit (allow machine to cool down) (Note: this fault IS NOT caused by a faulty sensor)
1 – 6	High Temp Warning – generator (allow machine to cool down) (Note: this fault IS NOT caused by a faulty sensor)
1 – 7	#1 cutting unit motor at zero (0) RPM for more than three (3) seconds (insufficient torque is available to rotate motor)
1 – 8	#2 cutting unit motor at zero (0) RPM for more than three (3) seconds (insufficient torque is available to rotate motor)
1 – 9	#3 cutting unit motor at zero (0) RPM for more than three (3) seconds (insufficient torque is available to rotate motor)
2 – 1	The master controller does not recognize the model number
2 – 2	All four (4) individual slaves (generator and all cutting unit motors) are offline on the CAN–Bus network
2 – 3	#1 cutting unit motor is offline on the CAN–Bus network
2 – 4	#2 cutting unit motor is offline on the CAN–Bus network
2 – 5	#3 cutting unit motor is offline on the CAN–Bus network
2 – 6	Generator is offline on the CAN–Bus network
2 – 9	TEC controller is faulty
3 – 1	Coolant sensor is faulty
3 – 2	Excessive engine temperature has caused engine shutdown
3 – 3	System voltage to #1 cutting unit motor is insufficient (motor will be disabled)
3 – 4	System voltage to #2 cutting unit motor is insufficient (motor will be disabled)
3 – 5	System voltage to #3 cutting unit motor is insufficient (motor will be disabled)
3 – 6	System voltage to generator is insufficient
3 – 7	Current to fan relay is excessive
3 – 9	TEC controller is faulty
4 – 1	Initial 48V system voltage is incorrect

Fault Code (Lamp Flashes)	Fault Description
4 – 3	Optional hydraulic oil temperature sensor is faulty (GR3420)
4 – 4	System voltage to generator and all cutting unit motors is insufficient (likely a 48V battery problem)
4 – 5	System voltage to generator and all cutting unit motors is excessive (e.g. incorrect batteries or charger problem)
4 – 6	Logic system voltage to generator and all cutting unit motors is excessive (e.g. incorrect batteries or charger problem)
4 – 7	Current to console high temperature warning light is excessive (GR3420)
4 – 9	Generator current is excessive
5 – 1	Engine alternator voltage output is incorrect
5 – 2	Engine alternator voltage output is excessive
5 – 4	Right fuse 2 (7.5 amp) for TEC outputs is faulty
5 – 5	Right fuse 3 (7.5 amp) for TEC outputs is faulty
5 – 6	Right fuse 4 (7.5 amp) for TEC outputs is faulty
5 – 7	Current to leak detector alarm (GR3320) or glow relay (GR3420) is excessive
5 – 9	48V contactor is faulty (stuck in closed position)
6 – 2	Generator speed is excessive
6 – 3	Location ID module is faulty
6 – 4	Main power relay is faulty (this fault could also indicate that all TEC output 7.5 amp fuses are faulty)
6 – 6	Controller software in cutting unit motors and/or generator incompatible with TEC controller
6 – 7	Current to solenoid coil S1 (lift/lower manifold) is excessive
6 – 9	Current to 48V contactor coil is excessive
7 – 1	Current to solenoid coil S2 (lift/lower manifold) is excessive
7 – 4	Current to solenoid coil S3 (lift/lower manifold) is excessive
7 – 6	Current to solenoid coil S4 (lift/lower manifold) is excessive
7 – 8	Current to solenoid coil PRV (mow manifold) is excessive
8 – 1	Current to start relay is excessive
8 – 3	CAN–Bus address issue existed
8 – 4	Current to E–reel enable relay is excessive
8 – 6	System voltage to #1 cutting unit motor is excessive (motor will be disabled)
8 – 7	System voltage to #2 cutting unit motor is excessive (motor will be disabled)
8 – 8	System voltage to #3 cutting unit motor is excessive (motor will be disabled)
8 – 9	System voltage to generator is excessive (generator will be disabled)
9 – 4	System voltage to #1 cutting unit motor is insufficient (motor will be disabled)
9 – 5	System voltage to #2 cutting unit motor is insufficient (motor will be disabled)
9 – 6	System voltage to #3 cutting unit motor is insufficient (motor will be disabled)

Fault Code (Lamp Flashes)	Fault Description
9 – 7	System voltage to generator is insufficient (generator will be disabled)
9 – 8	Logic system voltage to #1 cutting unit motor is excessive (motor will be disabled)
9 – 9	Logic system voltage to #2 cutting unit motor is excessive (motor will be disabled)
10 – 1	Logic system voltage to #3 cutting unit motor is excessive (motor will be disabled)
10 – 2	High current logic system voltage to generator is excessive (generator will be disabled)
10 – 3	Temperature sensors in generator are faulty (this fault identifies damage to the generator that requires generator replacement)
10 – 4	#1 cutting unit motor detected excessive current and disabled the motor
10 – 5	#2 cutting unit motor detected excessive current and disabled the motor
10 – 6	#3 cutting unit motor detected excessive current and disabled the motor
10 – 7	#1 cutting unit motor internal regulator identified excessive voltage (motor will not be disabled with this fault)
10 – 8	#2 cutting unit motor internal regulator identified excessive voltage (motor will not be disabled with this fault)
10 – 9	#3 cutting unit motor internal regulator identified excessive voltage (motor will not be disabled with this fault)
11 – 1	Generator internal regulator identified excessive voltage (generator will be disabled)
11 – 2	#1 cutting unit motor internal regulator identified insufficient voltage (motor will be disabled)
11 – 3	#2 cutting unit motor internal regulator identified insufficient voltage (motor will be disabled)
11 – 4	#3 cutting unit motor internal regulator identified insufficient voltage (motor will be disabled)
11 – 5	#1 cutting unit motor identified excessive rotation speed (motor will be disabled)
11 – 6	#2 cutting unit motor identified excessive rotation speed (motor will be disabled)
11 – 7	#3 cutting unit motor identified excessive rotation speed (motor will be disabled)
12 – 1	Hall sensor values in #1 cutting unit motor are invalid
12 – 2	Hall sensor values in #2 cutting unit motor are invalid
12 – 3	Hall sensor values in #3 cutting unit motor are invalid
12 – 4	Hall sensor values in generator are invalid
14 – 1	Controller software in #1 cutting unit motor is incompatible with TEC controller
14 – 2	Controller software in #2 cutting unit motor is incompatible with TEC controller
14 – 3	Controller software in #3 cutting unit motor is incompatible with TEC controller
14 – 4	Controller software in generator is incompatible with TEC controller
14 – 5	InfoCenter software is incompatible with TEC controller

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Hand Held Diagnostic Display

Your Greensmaster is equipped with a Toro Electronic Controller (TEC) which controls machine electrical functions. The controller monitors various input switches (e.g. ignition switch, seat switch, etc.) and energizes outputs to actuate solenoids or relays for the requested machine function.

For the controller to properly control the machine, each of the input switches, output solenoids and relays must be connected and functioning properly.

The Hand Held Diagnostic Display (see Special Tools in this chapter) is a tool to help the technician verify correct electrical functions of the machine.

IMPORTANT: The Hand Held Diagnostic Display must not be left connected to the machine. It is not designed to withstand the environment of the machine's every day use. When use of Diagnostic Display is completed, disconnect it from the machine and install protective cap to wire harness connector. Store Diagnostic Display in a dry, secure, indoor location and not on machine.

CAUTION

The interlock switches are for the protection of the operator and bystanders and to ensure correct operation of the machine. Do not bypass or disconnect interlock switches. Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine.

Verify Diagnostic Display Input Functions

1. Park machine on a level surface, lower the cutting units, engage the parking brake and stop the engine.

2. Tilt and support operator seat to access TEC controller. Locate wire harness connector for Hand Held Diagnostic Display near TEC controller. Carefully remove cap from harness connector (Fig. 27).

3. Connect the Hand Held Diagnostic Display connector to the wire harness connector. Make sure correct overlay decal is positioned on the Diagnostic Display (Fig. 28).

4. Turn the ignition switch to the RUN position, but do not start machine.

NOTE: The **red** text on the overlay decal refers to controller inputs and the **green** text refers to outputs.

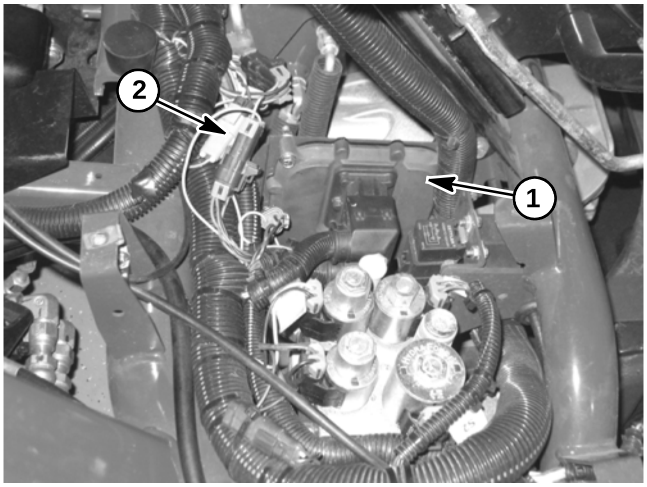
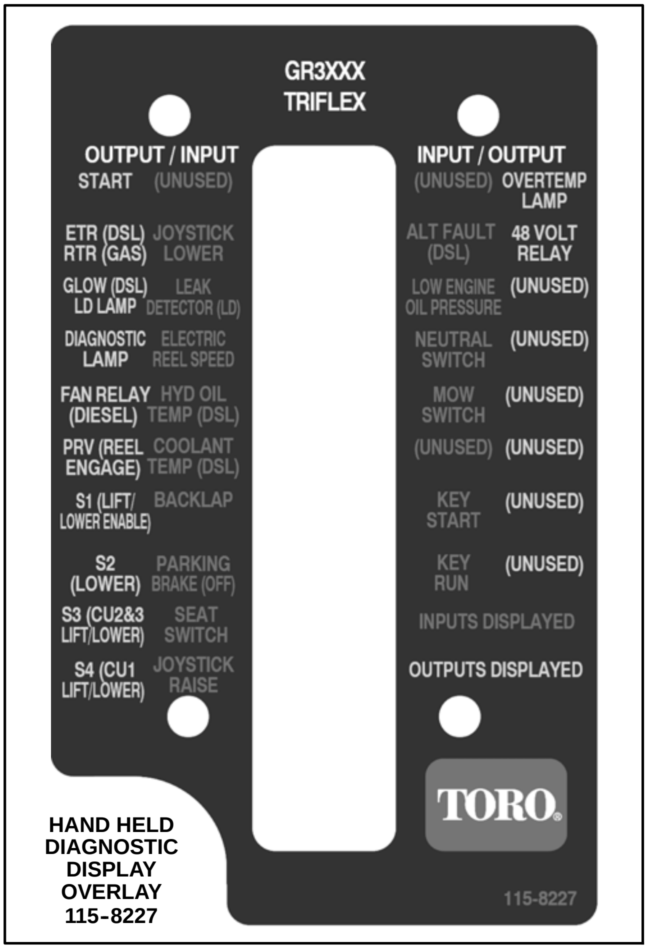


Figure 27

1. **TEC controller**
2. **Hand held connector**


GR3XXX
TRIFLEX
OUTPUT / INPUT
START (UNUSED)
ETR (DSL) RTR (GAS) JOYSTICK LOWER
GLOW (DSL) LD LAMP LEAK DETECTOR (LD)
DIAGNOSTIC LAMP ELECTRIC REEL SPEED
FAN RELAY (DIESEL) HYD OIL TEMP (DSL)
PRV (REEL ENGAGE) COOLANT TEMP (DSL)
S1 (LIFT/ LOWER ENABLE) BACKLAP
S2 (LOWER) PARKING BRAKE (OFF)
S3 (CU2&3 LIFT/LOWER) SEAT SWITCH
S4 (CU1 LIFT/LOWER) JOYSTICK RAISE
INPUT / OUTPUT
(UNUSED) OVERTEMP LAMP
ALT FAULT (DSL) 48 VOLT RELAY
LOW ENGINE OIL PRESSURE (UNUSED)
NEUTRAL SWITCH (UNUSED)
MOW SWITCH (UNUSED)
(UNUSED) (UNUSED)
KEY START (UNUSED)
KEY RUN (UNUSED)
INPUTS DISPLAYED
OUTPUTS DISPLAYED
TORO
115-8227

HAND HELD DIAGNOSTIC DISPLAY OVERLAY 115-8227

Figure 28

5. The “INPUTS DISPLAYED” LED, on lower right column of the Hand Held Diagnostic Display, should be illuminated. If the green “OUTPUTS DISPLAYED” LED is illuminated, press the toggle button on the Diagnostic Display to change to “INPUTS DISPLAYED” LED.

6. The Hand Held Diagnostic Display will illuminate the LED associated with each of the inputs when that input is in the position identified on the Diagnostic Display overlay. Individually, change the position of each of the inputs (i.e. sit on seat, move joystick, etc.), and note that the appropriate LED on the Diagnostic Display toggles on and off when the input state is changed (see Hand Held Diagnostic Display Inputs and LED Operation chart on next page). Repeat for all inputs that can be changed by hand.

7. If appropriate LED does not toggle on and off when input state is changed, check all wiring and connections to the switch for that input and/or test switch (see Component Testing in this chapter). Replace all defective switches and repair any damaged wiring.

NOTE: The LEAK DETECTOR controller input is only used on Greensmaster 3320 machines that are equipped with the Turf Guardian^{TM} Leak Detector System. The COOLANT TEMP, ALT FAULT and HYD TEMP controller inputs are only used on Greensmaster 3420 machines.

NOTE: On Greensmaster 3420 machines, the ALT FAULT controller input cannot be reliably tested by grounding the harness leads at the alternator. If the alternator is faulty, a TEC controller fault should have been detected. On machines with serial number below 312000000, the fault code will be retrieved using the diagnostic light (see Diagnostic Light (Serial Number Below 312000000) in this section). Use the InfoCenter Display for fault retrieval on machines with serial number above 312000000 (see InfoCenter Display (Serial Number Above 312000000) in this chapter).

NOTE: When the ignition switch is in the OFF position, all Hand Held Diagnostic Display LED’s should be OFF.

8. After input function testing is completed, disconnect the Hand Held Diagnostic Display from wire harness. Install cap into wire harness connector. Lower and secure seat.

Hand Held Diagnostic Display TEC Controller Inputs	Hand Held Diagnostic Display LED Operation
JOYSTICK LOWER	Joystick moved to lower (forward) position: LED ON Joystick NOT moved to lower position: LED OFF
LEAK DETECTOR (LD) (Optional for Greensmaster 3320 machines only)	Leak detector switch closed (oil level is low): LED ON Leak detector switch open (oil level is OK): LED OFF
ELECTRIC REEL SPEED	Reel speed control (potentiometer) and circuit wiring OK: LED ON Reel speed control (potentiometer) and circuit wiring faulty: LED OFF
HYD OIL TEMP (DSL) (Optional for Greensmaster 3420 machines only)	Hydraulic temperature, temp switch and circuit wiring OK: LED ON Hydraulic temperature, temp switch or circuit wiring faulty: LED OFF
COOLANT TEMP (DSL) (Greensmaster 3420 machines only)	Engine coolant temperature has exceeded 220^{o}F (105^{o}C): LED ON Engine coolant temperature below 220^{o}F (105^{o}C): LED OFF
BACKLAP	Backlap switch in backlap position: LED ON Backlap switch NOT in backlap position: LED OFF
PARKING BRAKE (OFF)	Parking brake released: LED ON Parking brake engaged: LED OFF
SEAT SWITCH	Seat occupied: LED ON Seat NOT occupied: LED OFF
JOYSTICK RAISE	Joystick moved to raise (rear) position: LED ON Joystick NOT moved to raise (rear) position: LED OFF
ALT FAULT (DSL) (Greensmaster 3420 machines only)	Engine not running OR alternator faulty: LED ON Alternator OK: LED OFF
LOW ENGINE OIL PRESSURE	Engine not running OR low engine oil pressure: LED ON Engine oil pressure OK: LED OFF
NEUTRAL SWITCH	Functional control lever in neutral: LED ON Functional control lever in mow or transport: LED OFF
MOW SWITCH	Functional control lever in mow: LED ON Functional control lever in neutral or transport: LED OFF
KEY START (NOTE: Place Functional Control Lever in MOW or TRANSPORT so engine will not start when turning ignition switch to START)	Ignition switch in START: LED ON Ignition switch in RUN: LED OFF
KEY RUN	Ignition switch in RUN or START: LED ON

NOTE: When the ignition switch is in the OFF position, all Hand Held Diagnostic Display LED's should be OFF.

NOTE: The COOLANT TEMP (DSL) input can be simulated by disconnecting the wire from the temperature sender on the engine and then grounding the wire. The appropriate input LED on the Diagnostic Display should illuminate when the wire is grounded and the ignition switch is in the ON position.

Verify Diagnostic Display Output Functions

The Hand Held Diagnostic Display has the ability to detect which output solenoids or relays are turned on by the TEC controller. This is a quick way to determine if a machine malfunction is electrical or hydraulic.

NOTE: An open output (e.g. an unplugged connector or a broken wire) cannot be detected with the Hand Held Diagnostic Display.

1. Park machine on a level surface, lower the cutting units, engage the parking brake and stop the engine.

2. Tilt and support operator seat to access TEC controller. Locate wire harness connector for Hand Held Diagnostic Display near TEC controller. Carefully remove cap from harness connector (Fig. 29).

3. Connect the Hand Held Diagnostic Display connector to the wire harness connector. Make sure correct overlay decal is positioned on the Diagnostic Display (see Special Tools in this chapter).

4. Turn the ignition switch to the RUN position.

NOTE: The **red** text on the overlay decal refers to controller inputs and the **green** text refers to controller outputs.

5. The green “OUTPUTS DISPLAYED” LED, on lower right column of the Hand Held Diagnostic Display, should be illuminated. If “INPUTS DISPLAYED” LED is illuminated, press the toggle button on the Diagnostic Display to change the LED to “OUTPUTS DISPLAYED”.

NOTE: It may be necessary to toggle between “INPUTS DISPLAYED” and “OUTPUTS DISPLAYED” several times to perform the following step. To change from inputs to outputs, press toggle button once. This may be done as often as required. **Do not press and hold toggle button**.

6. Sit on seat, start engine and attempt to operate the desired function of the machine. The appropriate output LED’s should illuminate on the Hand Held Diagnostic Display to indicate that the TEC controller is turning on that function (see Hand Held Diagnostic Display Outputs and LED Operation chart on next page). The outputs can be checked with the ignition switch in the RUN position and the engine not running.

NOTE: If the “DIAG. LAMP” output LED is blinking, this indicates that the TEC controller has detected a fault during machine operation. Refer to Diagnostic Light (Serial Number Below 312000000) or InfoCenter Display (Serial Number Above 312000000) in this section for information on retrieval and clearing of controller faults.

A. If the correct output LED’s do not illuminate, verify that the required input switches are in the necessary positions to allow that function to occur. Verify correct switch function.

B. If the output LED’s are on as specified, but the machine does not function properly, consider that the controller is operating correctly and a problem exists with some other component. Inspect electrical components and circuit for the affected function. Also, suspect a non-electrical problem (e.g. hydraulic component problem). Repair as necessary.

C. If each input switch is in the correct position and functioning correctly, but the output LED’s are not correctly illuminated, this may indicate a controller problem. If this occurs, contact your Toro Distributor for assistance.

7. After output function testing is completed, disconnect the Hand Held Diagnostic Display from wire harness. Install cap into wire harness connector. Lower and secure seat.

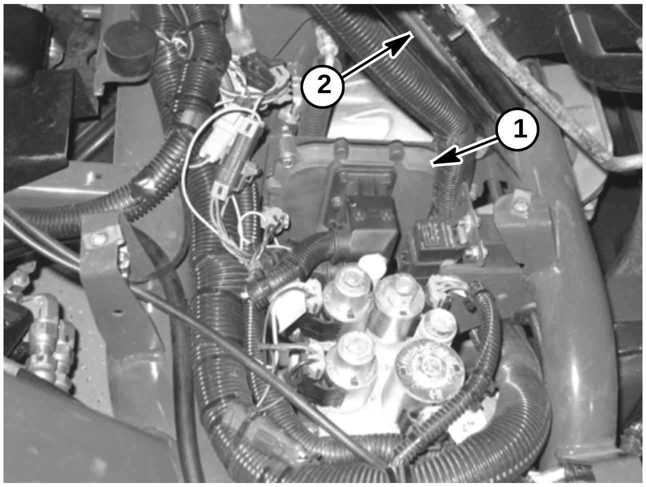


Figure 29

1. **TEC controller**
2. **Seat platform**

Hand Held Diagnostic Display Outputs	Hand Held Diagnostic Display LED Operation
START	TEC output exists to energize starter solenoid (Greensmaster 3320) or starter relay (Greensmaster 3420): LED ON No TEC output to starter solenoid or starter relay: LED OFF
ETR (DSL) RTR (Gas)	TEC output exists to energize engine run components (see NOTE below): LED ON No TEC output to engine run components: LED OFF
GLOW (DSL) LD LAMP	TEC output exists to energize leak detector indicator light and alarm (if equipped on Greensmaster 3320) or glow plug relay (Greensmaster 3420): LED ON No TEC output to leak detector light/alarm or glow plug relay: LED OFF
DIAGNOSTIC LAMP	Diagnostic lamp is ON or FLASHING: LED ON or FLASHING Diagnostic lamp is not ON or FLASHING: LED OFF
FAN RELAY (DIESEL) (Greensmaster 3420 machines only)	TEC output exists to energize cooling fan: LED ON No TEC output to energize cooling fan: LED OFF
PRV (REEL ENGAGE)	TEC output exists to energize mow manifold solenoid coil PRV: LED ON No TEC output to energize mow manifold solenoid coil PRV: LED OFF
S1 (LIFT/ LOWER ENABLE)	TEC output exists to energize lift manifold solenoid coil S1: LED ON No TEC output to lift manifold solenoid coil S1: LED OFF
S2 (LOWER)	TEC output exists to energize lift manifold solenoid coil S2: LED ON No TEC output to lift manifold solenoid coil S2: LED OFF
S3 (CU2&3 LIFT/LOWER)	TEC output exists to energize lift manifold solenoid coil S3: LED ON No TEC output to lift manifold solenoid coil S3: LED OFF
OVERTEMP LAMP (Greensmaster 3420 machines only)	Console high temperature warning light is ON: LED ON Console high temperature warning light is not ON: LED OFF
48 VOLT RELAY	TEC output exists to energize 48 volt E–reels enable relay: LED ON No TEC output to energize 48 volt E–reels enable relay: LED OFF

NOTE: ETR (Energize To Run) engine run components on Greensmaster 3420 machines (diesel engine) include the fuel pump and fuel solenoid hold coil. RTR (Relay To Run) engine run components on Greensmaster 3320 machines (gasoline engine) include the kill relay, charge relay and carburetor fuel solenoid.

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Starting Problems

NOTE: Check Diagnostic Light (serial number below 312000000) or InfoCenter display (serial number above 312000000) for possible operator advisories or faults whenever diagnosing machine electrical problems.

Problem	Possible Causes
Starter solenoid clicks, but starter will not crank (if solenoid clicks, problem is not in safety interlock system).	12VDC battery cables are loose or corroded. 12VDC battery ground to frame is loose or corroded. 12VDC battery is discharged or faulty. Wiring at starter is loose or faulty. Starter mounting bolts are loose or not supplying a sufficient ground. Starter solenoid is faulty. Starter motor is faulty.
Nothing happens when start attempt is made. **NOTE:** If diagnostic light or InfoCenter light is blinking and machine functions are inoperable, a 48V precharge fault may exist. In this instance, disconnect reel motor cables one at a time to see if a reel motor is the cause of the problem. If light continues to blink after all motors are disconnected, generator controller may be faulty or 48V battery pack polarity may be incorrect.	Functional control lever is not in the NEUTRAL position. The parking brake is disengaged and the operator seat is unoccupied. 12VDC battery cables are loose or corroded. 12VDC battery is discharged or faulty. Fuse(s) is (are) faulty (see Fuse Block in the Component Testing section of this chapter). The fusible link harness at the engine starter motor is faulty (see Fusible Links in the Component Testing section of this chapter). Wiring to the start circuit components is loose, corroded or damaged (see electrical schematic in Chapter 10 – Foldout Drawings). Neutral switch is out of adjustment or is faulty. The ignition switch or circuit wiring is faulty. Starter solenoid or circuit wiring is faulty. Main power relay or circuit wiring is faulty. Fuse block is faulty. TEC controller is faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	The fuel tank is empty. The fuel filter is plugged. Engine and/or fuel may be too cold. Wiring to start circuits is loose, corroded or damaged (see electrical schematic in Chapter 10 – Foldout Drawings). Engine or fuel system is malfunctioning (see Chapter 3 – Gasoline Engine or Chapter 4 – Diesel Engine). Kill relay or circuit wiring is faulty (Greensmaster 3320 machines). Fusible link to fuel solenoid pull coil is faulty (Greensmaster 3420) (see Fusible Links in the Component Testing section of this chapter). Fuel solenoid or circuit wiring is faulty. Fuel pump or circuit wiring is faulty (Greensmaster 3420 machines). The engine glow plug circuit does not operate properly (Greensmaster 3420 machines) (see below).
Engine cranks (but should not) with the functional control lever in the MOW or TRANSPORT position.	Neutral switch is out of adjustment or is faulty. Circuit wiring for neutral switch is loose, corroded or damaged.
The engine glow plug circuit does not operate properly (Greensmaster 3420 machines).	Wiring in the engine glow circuit is loose, corroded or damaged (see electrical schematic in Chapter 10 – Foldout Drawings). One (or more) of the engine glow plugs is faulty. Fuse(s) is (are) faulty (see Fuse Block in the Component Testing section of this chapter). The fusible link harness at the engine starter motor is faulty (see Fusible Links in the Component Testing section of this chapter). The glow relay is faulty. The TEC Controller is faulty.
The engine starts, but stops when the ignition switch is released from the START position (Greensmaster 3420 machines).	The engine fuel stop solenoid or circuit wiring is faulty (pull coil operates but hold coil or circuit wiring is faulty). Fuse(s) is (are) faulty (other electrical components most likely affected as well). The ignition switch is faulty.

General Run and Transport Problems

NOTE: Check Diagnostic Light (serial number below 312000000) or InfoCenter display (serial number above 312000000) for possible operator advisories or faults whenever diagnosing machine electrical problems.

Problem	Possible Causes
Engine kills when the functional control lever is in the MOW or TRANSPORT position with the operator in the seat.	Operator is sitting too far forward on the seat (seat switch not depressed). Parking brake is engaged. Parking brake switch is out of adjustment or is faulty. Parking brake switch wiring is loose, corroded or damaged. Seat switch is faulty. Seat switch wiring is loose, corroded or damaged.
Machine battery (12VDC) does not charge.	Wiring to the charging circuit components is loose, corroded or damaged (see electrical schematic in Chapter 10 – Foldout Drawings). Voltage regulator is loose or not grounded to engine (Greensmaster 3320 machines). Charge circuit relay or circuit wiring is faulty (Greensmaster 3320 machines). The engine alternator belt is loose or damaged (Greensmaster 3420 machines). Alternator fusible link in the fusible link harness is faulty. 12VDC battery is faulty. Alternator/voltage regulator is faulty.
Engine kills during operation (operator sitting on seat).	Operator moved too far forward on the seat (seat switch not depressed). The parking brake was engaged or the parking brake sensor is out of adjustment or faulty. The seat switch or circuit wiring is faulty. Engine coolant temperature is excessive (Greensmaster 3420). Wiring to run circuit components is loose, corroded or damaged (see electrical schematic in Chapter 10 – Foldout Drawings).

Cutting Unit Operating Problems

NOTE: Check Diagnostic Light (serial number below 312000000) or InfoCenter display (serial number above 312000000) for possible operator advisories or faults whenever diagnosing machine electrical problems.

Problem	**Possible Causes**
Cutting units will not raise.	Wiring to raise circuit components is loose, corroded or damaged (see electrical schematic in Chapter 10 – Foldout Drawings). Fuse or fuse block is faulty (see Fuse Block in the Component Testing section of this chapter). Raise switch in joystick assembly is faulty. Lift manifold solenoid valve coil(s) (S1, S3 and/or S4) or circuit wiring is faulty. A hydraulic problem exists (see Chapter 5 – Hydraulic System). The TEC Controller is faulty (fault code should have been generated).
Cutting units will not lower.	Wiring to lower circuit components is loose, corroded or damaged (see electrical schematic in Chapter 10 – Foldout Drawings). Fuse or fuse block is faulty (see Fuse Block in the Component Testing section of this chapter). Lower switch in joystick assembly is faulty. Lift manifold solenoid valve coil(s) (S1, S2, S3 and/or S4) or circuit wiring is faulty. A hydraulic problem exists (see Chapter 5 – Hydraulic System). The TEC Controller is faulty (fault code should have been generated).
Cutting units run (but should not) when raised.	Mow switch is faulty or out of adjustment. The TEC Controller is faulty (fault code should have been generated).

Cutting Unit Operating Problems (Continued)

Problem	Possible Causes
None of the cutting units run when lowered with the functional control lever in the MOW position. **NOTE:** Make sure to check for machine electrical fault to assist with troubleshooting. Also, use Hand Held Diagnostic Display or InfoCenter Display to verify operation of safety interlock system. **NOTE:** If a cutting unit motor is faulty, other cutting unit motors will start and run for several seconds and then will shut off.	The cutting unit power disconnect couplers are not connected (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). Wiring to run/mow/backlap circuit components is loose, corroded or damaged (see electrical schematic in Chapter 10 – Foldout Drawings). Fuse or fuse block is faulty (see Fuse Block in the Component Testing section of this chapter). 10 amp fuse or fuse holder in the E–reels circuit is faulty (see Electric Reel Drive System (48 Volt DC) Fuses in the Component Testing section of this chapter). Mow switch is out of adjustment. Mow switch or circuit wiring is faulty. E–reels enable relay or circuit wiring is faulty (fault code should have been generated). CAN–bus termination resistor(s) is faulty or missing (fault code should have been generated). The TEC Controller is faulty (fault code should have been generated).
One of the cutting units does not run when lowered with the functional control lever in the MOW position. **NOTE:** If a cutting unit motor is faulty, moving the suspected faulty motor to one of the other cutting units should move the problem to the new location.	A problem with the affected cutting unit exists (see Chapter 8 – DPA Cutting Units). The affected cutting unit motor is faulty (fault code should have been generated).

NOTE: If a problem exists with either the generator assembly or the electric reel drive system (48 volt DC) battery pack, a fault should have been generated. Check the Diagnostic Light (serial number below 312000000) or InfoCenter display (serial number above 312000000) for possible faults.

Electrical System Quick Checks

12 Volt Battery Test

Use a multimeter to measure the voltage between the battery terminals.

Set the multimeter to the DC volts setting. The battery should be at a temperature of 60º to 100º F (16º to 37º C). The ignition key should be off and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead the negative battery post.

NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information (see Battery Service in the Service and Repairs section of this chapter).

Voltage Measured	Battery Charge Level
12.68 VDC (or higher)	Fully charged (100%)
12.45 VDC	75% charged
12.24 VDC	50% charged
12.06 VDC	25% charged
11.89 VDC	0% charged

Engine Charging System Test

This is a simple test used to determine if the engine charging system is functioning. It will tell you if the charging system has an output, but not its capacity.

Use a digital multimeter set to DC volts. Connect the positive (+) multimeter lead to the positive battery post and the negative (–) multimeter lead to the negative battery post. Keep the test leads connected to the battery posts and record the battery voltage.

NOTE: Upon starting the engine, the battery voltage will drop and then should increase once the engine is running.

NOTE: Depending upon the condition of the battery charge and battery temperature, the battery voltage will increase at different rates as the battery charges.

Start the engine and run at high idle. Allow the battery to charge for at least three (3) minutes. Record the battery voltage.

After running the engine for at least three (3) minutes, battery voltage should be at least 0.50VDC higher than initial battery voltage.

An example of a charging system that is functioning:

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30V
Battery Voltage after 3 Minute Charge	= 12.95V
Difference	= +0.65V

Glow Plug System Test (Greensmaster 3420)

This is a fast, simple test that can help to determine the integrity and operation of your Greensmaster 3420 glow plug system. The test should be run anytime hard starting (cold engine) is encountered on a diesel engine equipped with a glow plug system.

Use a digital multimeter and/or inductive ammeter (AC/DC Current Transducer). Properly connect the ammeter to the digital multimeter (refer to manufacturers' instructions) and set the multimeter to the correct scale. With the ignition switch in the OFF position, place the ammeter pickup around the main glow plug power supply wire and read the meter prior to activating the glow plug system. Adjust the meter to read zero (if applicable). Activate the glow plug system by turning the ignition switch to RUN and record the multimeter results.

The Greensmaster 3420 glow plug system should have a reading of approximately 27 amps total (nine (9) amps per glow plug). If low current reading is observed, one (or more) of the glow plugs is faulty.

Parking Brake Switch

The parking brake switch is a normally open proximity switch that mounts to the frame bracket used to attach the parking brake lever assembly (Fig. 30). The sensing plate for the brake switch is a tab on the parking brake lever assembly. The Toro Electronic Controller (TEC) monitors the operation of the parking brake switch.

When the parking brake is not applied, the tab on the parking brake lever is positioned near the target end of the parking brake switch causing the switch to close. The tab on the parking brake lever is moved away from the switch when the parking brake is applied causing the switch to open.

Adjustment

1. When the parking brake is not applied, the gap between the parking brake switch and the tab on the parking brake lever should be **0.125" (3.2 mm)** (Fig. 30).

2. If gap is incorrect, loosen jam nuts that secure switch to frame bracket. Position switch with jam nuts to allow correct gap between switch and brake lever tab. Tighten jam nuts to secure adjustment. Jam nuts should be torqued from **162 to 198 in-lb (18.4 to 22.4 N-m)**. After jam nuts are tightened, make sure that clearance between head of parking brake switch and tab on the parking brake lever has not changed.

3. After adjustment to the parking brake switch, use the Hand Held Diagnostic Display to verify that parking brake switch and circuit wiring are functioning correctly (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter).

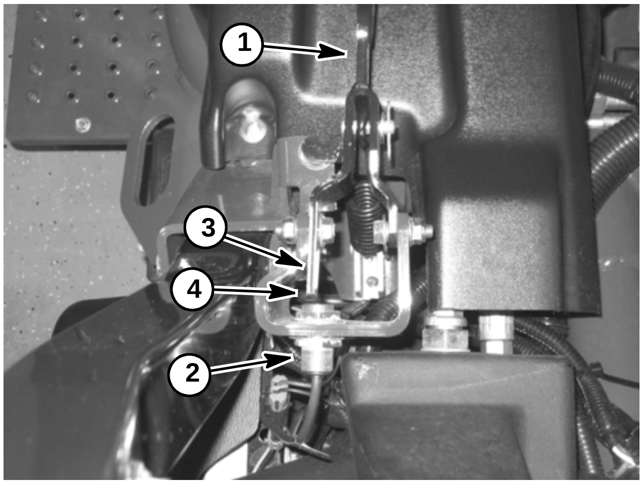
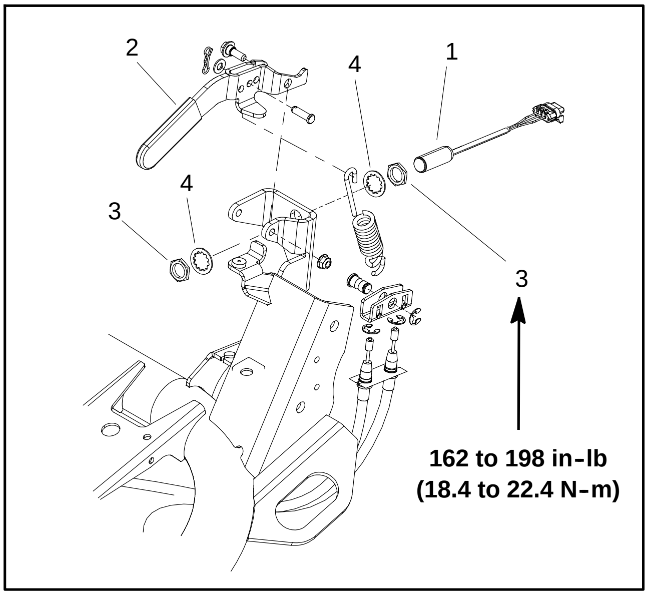


Figure 30

1. Brake lever	**3. Brake lever tab**
2. Parking brake switch	**4. Gap**



162 to 198 in-lb (18.4 to 22.4 N-m)

Figure 31

1. Parking brake switch	**3. Jam nut (2 used)**
2. Parking brake lever	**4. Lock washer (2 used)**

Neutral and Mow Switches

The neutral and mow switches are normally open proximity switches that mount to the console assembly (Fig. 32). The sensing plate for these switches is a tab on the functional control lever. The Toro Electronic Controller (TEC) monitors the operation of the neutral and mow switches.

When the functional control lever is in the neutral position, the tab on the lever is positioned near the target end of the neutral switch causing the switch to close. The tab on the functional control lever is moved away from the neutral switch when the lever is in either the mow or transport position causing the switch to be in its normal open state.

When the functional control lever is in the mow position, the tab on the lever is positioned near the target end of the mow switch causing the switch to close. The tab on the functional control lever is moved away from the mow switch when the lever is in either the neutral or transport position causing the switch to be in its normal open state.

Adjustment

1. Remove console cover from console assembly to gain access to switches (see Control Console Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

2. When the functional control lever is placed in the neutral or mow position, the gap between the appropriate switch head and the tab on the functional lever should be from **0.090” to 0.120” (2.3 to 3.0 mm)** (Fig. 33).

3. If gap is incorrect, loosen jam nuts that secure switch to console bracket. Position switch with jam nuts to allow correct gap between switch head and functional lever tab. Tighten jam nuts to secure adjustment. Jam nuts should be torqued from **162 to 198 in–lb (18.4 to 22.4 N–m)**. After jam nuts are tightened, make sure that clearance between head of switch and tab on the functional lever has not changed.

4. After adjustment to the switch(es), use the Hand Held Diagnostic Display to verify that neutral and mow switches and circuit wiring are functioning correctly (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter).

5. Secure console cover to console assembly (see Control Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

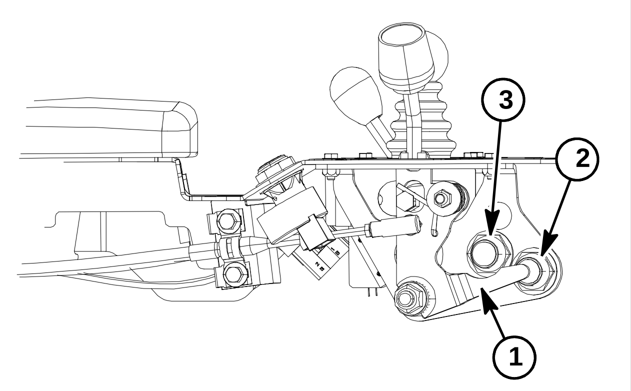


Figure 32

1. **Functional lever tab**
2. **Mow switch**
3. **Neutral switch**

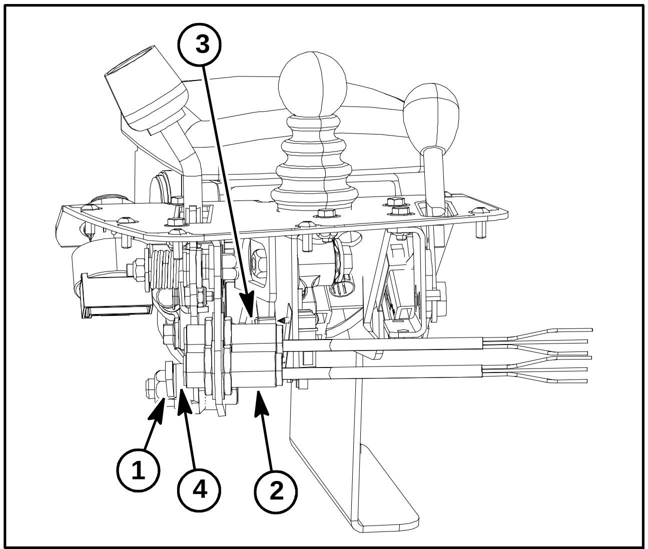


Figure 33

1. **Functional lever tab**
2. **Mow switch**
3. **Neutral switch**
4. **Gap**

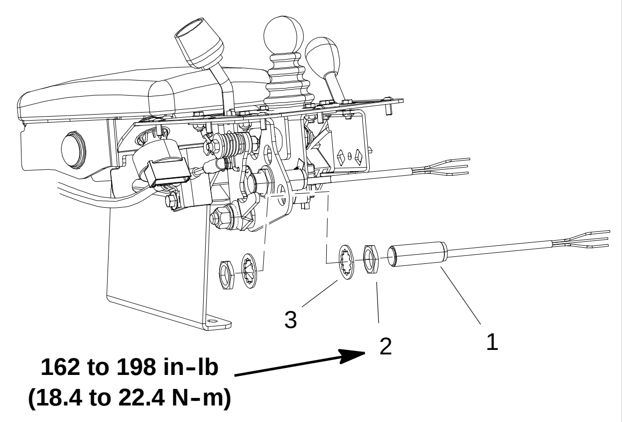


Figure 34

1. **Switch (mow shown)**
2. **Jam nut (2 used)**
3. **Lock washer (2 used)**

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the ignition switch connector before doing a continuity check).

NOTE: For engine component testing information, refer to the appropriate engine service manual (Briggs & Stratton Repair Manual or Kubota Workshop Manual).

CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Ignition Switch (Serial Number Below 312000000)

The ignition (key) switch is located on the control panel and has three (3) positions: STOP, RUN and START (Fig. 35). The Toro Electronic Controller (TEC) monitors the operation of the ignition switch.

NOTE: The engine can only be started when the functional control lever is in the NEUTRAL position and either the seat is occupied or the parking brake is engaged. Also, the TEC controller limits engine cranking time to thirty (30) seconds.

Testing

1. Park machine on a level surface, lower cutting units, engage parking brake and stop engine. Remove key from ignition switch.

2. Before disconnecting the ignition switch for testing, the switch and its circuit wiring should be tested as a TEC electrical input using the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter). If input testing verifies that the ignition switch and circuit wiring **are** functioning correctly, no further ignition switch testing is necessary. If, however, input testing determines that the ignition switch and circuit wiring **are not** functioning correctly, proceed with the following ignition switch testing procedure.

3. Remove console cover from console assembly to gain access to ignition switch (see Control Console Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

4. Make sure ignition switch is in the OFF position. Disconnect wire harness connector from ignition switch.

5. The ignition switch terminals are identified in Figure 35 and the circuitry of the switch is shown in the chart in Figure 36. With the use of a multimeter (ohms setting), the switch functions can be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

6. Replace ignition switch if testing determines that it is faulty.

7. If the ignition switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

8. After testing is complete, connect machine wire harness connector to ignition switch. Secure console cover to machine with removed fasteners.

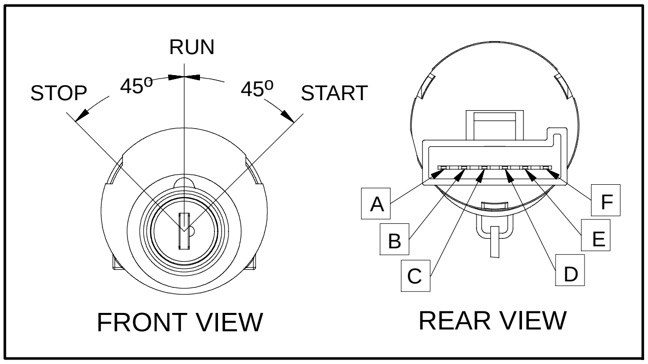


Figure 35

SWITCH POSITION	CIRCUITS
STOP	NONE
RUN	B + C + F, D + E
START	A + B + C

Figure 36

Ignition Switch (Serial Number Above 312000000)

The ignition (key) switch is located on the control panel and has three (3) positions: STOP, RUN and START (Fig. 37). The Toro Electronic Controller (TEC) monitors the operation of the ignition switch.

NOTE: The engine can only be started when the functional control lever is in the NEUTRAL position and either the seat is occupied or the parking brake is engaged. Also, the TEC controller limits engine cranking time to thirty (30) seconds.

Testing

1. Park machine on a level surface, lower cutting units, engage parking brake and stop engine. Remove key from ignition switch.

2. Before disconnecting the ignition switch for testing, the switch and its circuit wiring should be tested as a TEC electrical input using the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter) or InfoCenter Display (see InfoCenter Display in this chapter). If input testing verifies that the ignition switch and circuit wiring **are** functioning correctly, no further ignition switch testing is necessary. If, however, input testing determines that the ignition switch and circuit wiring **are not** functioning correctly, proceed with the following ignition switch testing procedure.

3. Remove console cover from console assembly to gain access to ignition switch (see Control Console Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

4. Make sure ignition switch is in the OFF position. Disconnect wire harness connector from ignition switch.

5. The ignition switch terminals are identified in Figure 37 and the circuitry of the switch is shown in the chart in Figure 38. With the use of a multimeter (ohms setting), the switch functions can be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

6. Replace ignition switch if testing determines that it is faulty.

7. If the ignition switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

8. After testing is complete, connect machine wire harness connector to ignition switch. Secure console cover to machine with removed fasteners.

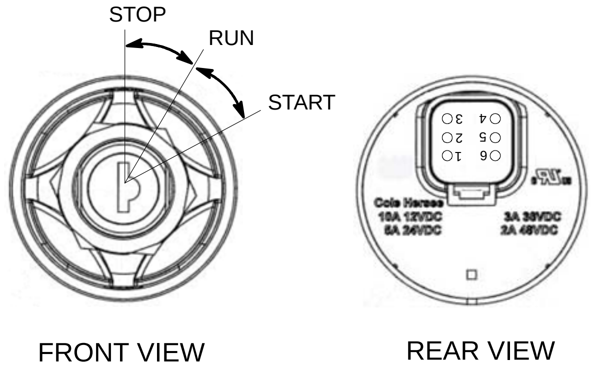


Figure 37

SWITCH POSITION	CIRCUITS
STOP	1 + 6
RUN	1 + 3 + 4 + 5 + 6
START	1 + 2 + 4 + 5 + 6

Figure 38

NOTE: Ignition switch terminals 1 and 6 are connected internally. Terminals 4 and 5 are also connected internally. These terminals should have continuity regardless of switch position.

Engine Oil Pressure Indicator Light (Greensmaster 3320 with Serial Number Below 312000000)

The engine oil pressure indicator light on Greensmaster 3320 machines with serial number below 312000000 should come on when the ignition switch is in the RUN position with the engine not running. Also, it should illuminate with the engine running if the engine oil pressure drops to an unsafe level.

IMPORTANT: If the oil pressure indicator light is illuminated with the engine running, shut off the engine immediately.

To test the oil pressure light and circuit wiring, ground the wire attached to oil pressure switch located on the engine near the oil filter. Turn ignition switch to the RUN position; the engine oil pressure light should come on indicating correct operation of the indicator light and circuit wiring.

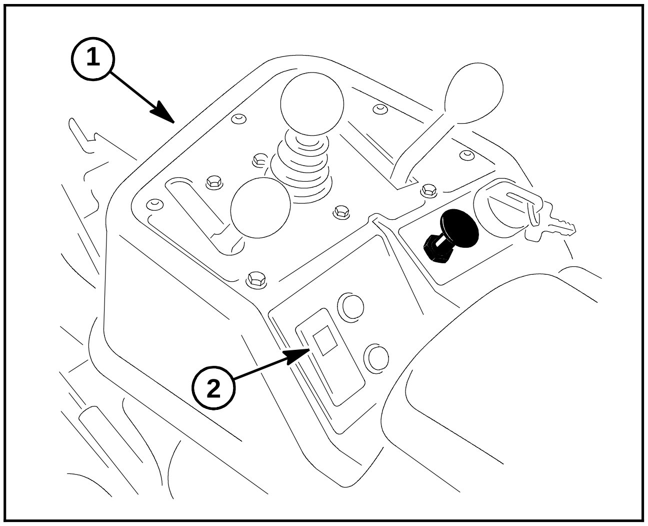


Figure 39

1. **Control console**
2. **Oil pressure light**

Indicator Lights (Greensmaster 3420 with Serial Number Below 312000000)

Charge Indicator Light

The charge indicator light should come on when the ignition switch is in the RUN position with the engine not running. Also, it should illuminate with an improperly operating charging circuit while the engine is running.

Engine Oil Pressure Light

The engine oil pressure light should come on when the ignition switch is in the RUN position with the engine not running. Also, it should illuminate with the engine running if the engine oil pressure drops to an unsafe level.

IMPORTANT: If the oil pressure indicator light is illuminated with the engine running, shut off the engine immediately.

To test the oil pressure light and circuit wiring, ground the wire attached to oil pressure switch located on the engine near the oil filter. Turn ignition switch to the RUN position; the engine oil pressure light should come on indicating correct operation of the indicator light and circuit wiring.

High Temperature Warning Light

If the engine coolant temperature reaches 220°F (105°C) (approximate), the high temperature warning light will come on.

To test the high temperature warning light and circuit wiring, turn ignition switch to the RUN position and ground the wire attached to high temperature warning switch located on the engine water pump housing (see High Temperature Warning Switch in this section). The high temperature warning light should illuminate when the wire is grounded.

Glow Plug Indicator Light

The glow plug indicator light should come on when the ignition switch is placed in the RUN position prior to placing the ignition switch in START. The light should stay lit for approximately six (6) seconds while the ignition switch is left in the RUN position.

Testing Indicator Lights

1. Remove console cover from console assembly to gain access to indicator lights (see Control Console Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

2. Apply 12 VDC to terminals 1A and 2A (Fig. 41) and ground terminals 1B and 2B (Fig. 41).

3. Both indicator lights should illuminate.

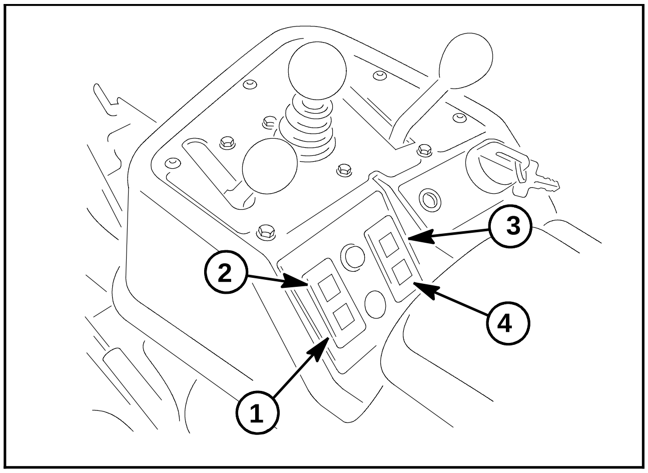


Figure 40

1. **Charge indicator light**
2. **Oil pressure light**
3. **High temp warning light**
4. **Glow plug light**

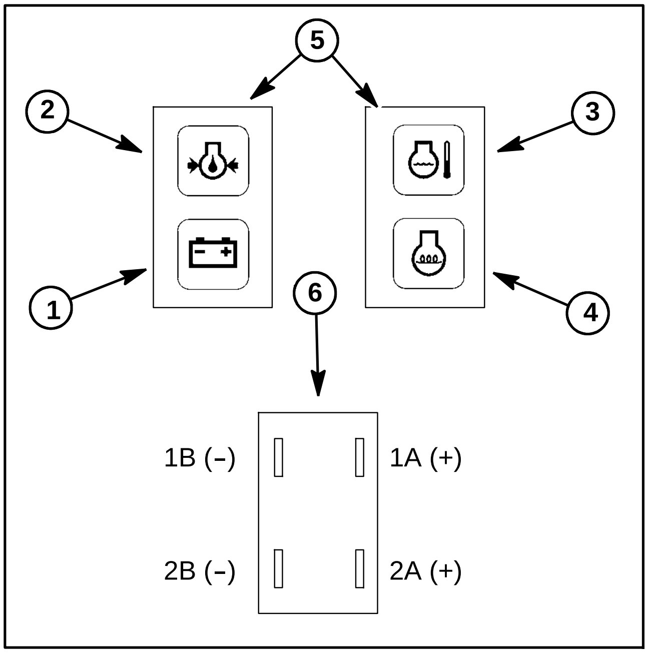


Figure 41

1. **Charge indicator**
2. **Engine oil pressure**
3. **High temperature**
4. **Glow plug indicator**
5. **Indicator light front**
6. **Indicator light back**

Fuse Block (Greensmaster 3320)

The fuse block on Greensmaster 3320 machines is attached to the frame under the operator seat (Fig. 42).

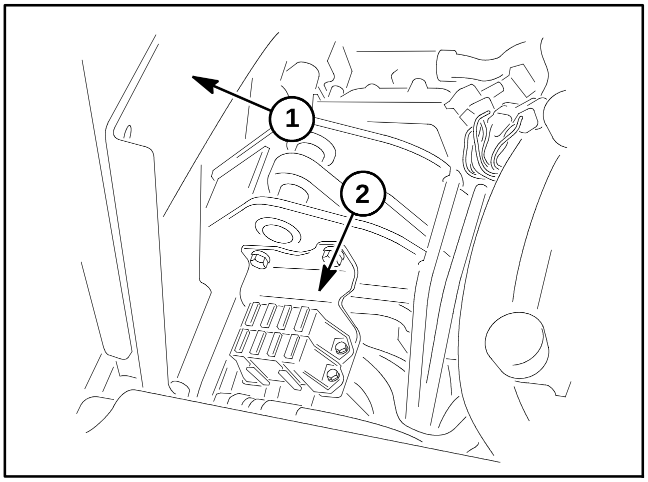


Figure 42

1. **Seat base (raised)**
2. **Fuse block**

Fuse Identification and Function

Use Figure 43 to identify each individual fuse and its correct amperage. Fuses for Greensmaster 3320 machines have the following function:

Right Fuse 1 (2 Amp): Protects TEC logic and ignition switch power supply circuits.

Right Fuse 2 (7.5 Amp): Protects TEC output power supply for start solenoid, charge circuit relay, kill relay, fuel solenoid, optional leak detector (alarm and indicator light) and console diagnostic light (if equipped).

Right Fuse 3 (7.5 Amp): Protects TEC output power supply for cutting reels engage solenoid, lift enable solenoid (S1), lift/lower solenoid (S2) and optional hydraulic oil cooling fan relay.

Right Fuse 4 (7.5 Amp): Protects TEC output power supply for lift solenoids S3 (front cutting units) and S4 (center cutting unit).

Left Fuse 1 (10 Amp): Protects power supply for hour meter, low engine oil pressure indicator light (if equipped), proximity switches (parking brake, neutral and mow) and InfoCenter Display (if equipped).

Left Fuse 2 (15 Amp): Protects power supply for optional Turf Defender^{TM} Leak Detector solenoid and optional lights.

Left Fuse 3: Not used.

Left Fuse 4 (15 Amp): Protects power supply for optional hydraulic oil cooling fan.

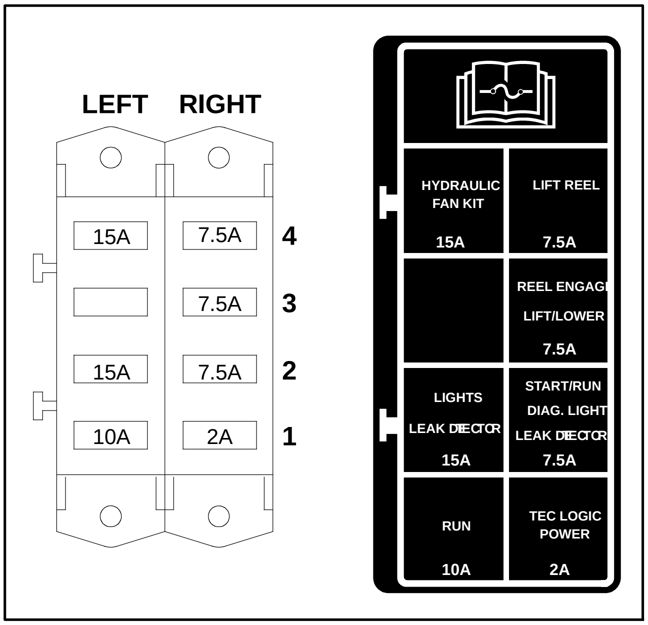

LEFT
RIGHT
15A
7.5A
4
7.5A
3
15A
7.5A
2
10A
2A
1
HYDRAULIC FAN KIT
15A
LIFT REEL
7.5A
REEL ENGAG
LIFT/LOWER
7.5A
LIGHTS
LEAK DETECTOR
15A
START/RUN
DIAG. LIGHT
LEAK DETECTOR
7.5A
RUN
10A
TEC LOGIC POWER
2A

Figure 43

Fuse Testing

Make sure that ignition switch is OFF and key is removed from switch. Remove fuses from the fuse block for testing. Fuse should have continuity between fuse terminals.

Fuse Block (Greensmaster 3420 with Serial Number Below 312000000)

The fuse block on Greensmaster 3420 machines is attached to the frame under the operator seat (Fig. 44).

In addition to the fuses in the fuse block, a 50 amp maxi–fuse is included in the wire harness. This fuse protects the engine cooling fan circuit and resides in a fuse holder under the right side cover next to operator seat.

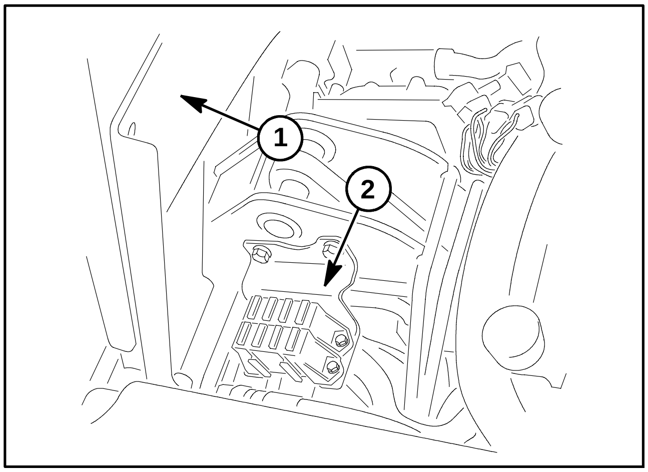


Figure 44

1. **Seat base (raised)**
2. **Fuse block**

Fuse Identification and Function

Use Figure 45 to identify each individual fuse and its correct amperage. Fuses for Greensmaster 3420 machines have the following function:

Right Fuse 1 (2 Amp): Protects TEC logic and ignition switch power supply circuits.

Right Fuse 2 (7.5 Amp): Protects TEC output power supply for start relay, engine run solenoid, fuel pump, glow relay, glow plug indicator light and console diagnostic light.

Right Fuse 3 (7.5 Amp): Protects TEC output power supply for fan relay, cutting reels engage solenoid, lift enable solenoid (S1) and lift/lower solenoid (S2).

Right Fuse 4 (7.5 Amp): Protects TEC output power supply for lift solenoids S3 (front cutting units), S4 (center cutting unit) and over temperature indicator light.

Left Fuse 1 (10 Amp): Protects power supply for hour meter, low engine oil pressure indicator light, alternator indicator light and proximity switches (parking brake, neutral and mow).

Left Fuse 2 (15 Amp): Protects power supply for start relay and solenoid.

Left Fuse 3 (15 Amp): Protects power supply for optional Turf Defender^{TM} Leak Detector system and optional lights.

Left Fuse 4: Not used.

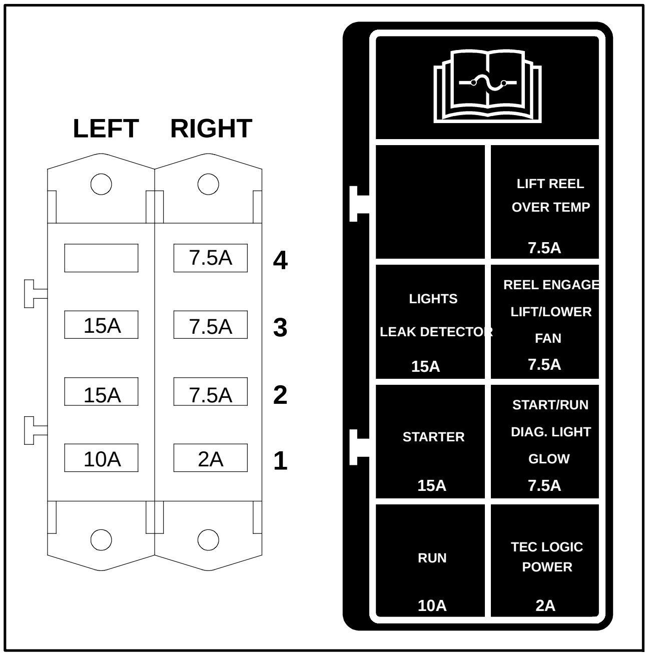


Figure 45

Fuse Testing

Make sure that ignition switch is OFF and key is removed from switch. Remove fuses from the fuse block for testing. Fuse should have continuity between fuse terminals.

Fuse Block (Greensmaster 3420 with Serial Number Above 312000000)

The fuse block on Greensmaster 3420 machines is attached to the frame under the operator seat (Fig. 46).

In addition to the fuses in the fuse block, a 50 amp maxi–fuse is included in the wire harness. This fuse protects the engine cooling fan circuit and resides in a fuse holder under the right side cover next to operator seat.

Fuse Identification and Function

Use Figure 47 to identify each individual fuse and its correct amperage. Fuses for Greensmaster 3420 machines with a serial number above 312000000 have the following function:

Right Fuse 1 (2 Amp): Protects TEC logic and ignition switch power supply circuits.

Right Fuse 2 (7.5 Amp): Protects TEC output power supply for start relay, engine run solenoid, fuel pump and glow relay.

Right Fuse 3 (7.5 Amp): Protects TEC output power supply for fan relay, cutting reels engage solenoid, lift enable solenoid (S1) and lift/lower solenoid (S2).

Right Fuse 4 (7.5 Amp): Protects TEC output power supply for lift solenoids S3 (front cutting units) and S4 (center cutting unit).

Left Fuse 1 (10 Amp): Protects power supply for start relay and starter solenoid.

Left Fuse 2 (10 Amp): Protects power supply for hour meter, InfoCenter display, proximity switches (parking brake, neutral and mow) and backlap switch indicator light.

Left Fuse 3 (15 Amp): Protects power supply for optional Turf Defender^{TM} Leak Detector system and optional lights.

Left Fuse 4: Not used.

Fuse Testing

Make sure that ignition switch is OFF and key is removed from switch. Remove fuses from the fuse block for testing. Fuse should have continuity between fuse terminals.

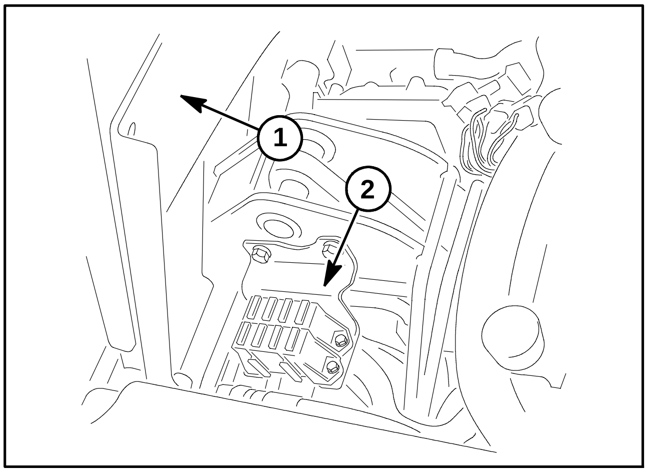


Figure 46

1. **Seat base (raised)**
2. **Fuse block**

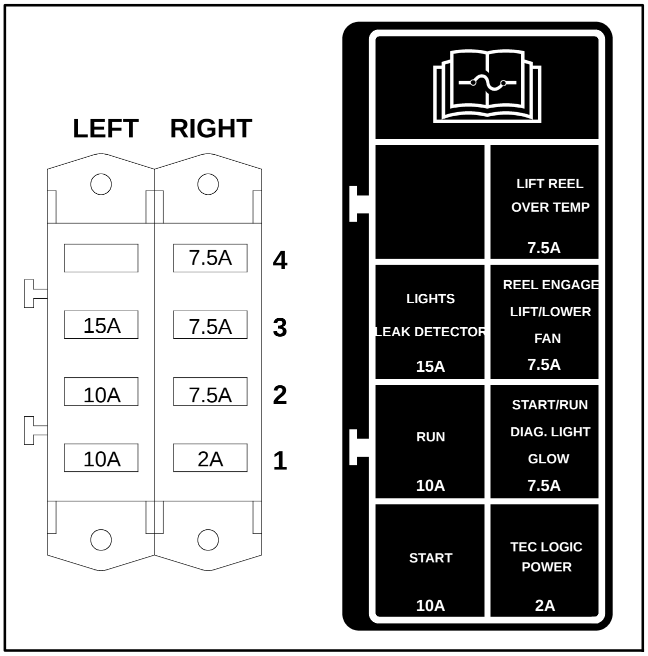


Figure 47

Electric Reel Drive System (48 Volt DC) Fuses

Several fuses are used in the electric reel drive system for circuit protection. These fuses plug into fuse holders and are located under the side cover next to the operator seat.

Fuse Identification and Function

Use Figures 47, 48 and 49 (if equipped) to identify the electric reel drive system fuses.

10 Amp Fuse (Fig. 47): Protects logic power supply circuits for the generator and electric reel motors. **NOTE:** The 10 amp fuse holder is a component of the electric reel wire harness.

60 Amp Maxi Fuse (Fig. 48): Protects main 48 VDC power supply. **NOTE:** The 60 amp fuse holder wire connections are attached to the negative (-) terminal on the forward battery and the junction block next to the battery pack.

35 Amp Reel Motor Fuses (machines with serial number above 315000000) (Fig. 49): Protect the 48 VDC power supply circuits for the electric reel motors. The reel motor fuses are located in a fuse holder under the right side cover next to the operator seat.

Fuse Testing

1. Make sure that ignition switch is OFF and key is removed from switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Remove left side cover next to operator seat to allow access to electric reel drive system fuses.

4. Remove fuse from the fuse holder for testing.

5. Fuse should have continuity between fuse terminals.

IMPORTANT: Fuses used in the electric reel drive system are 58 volt fuses. Make sure that correct fuses are used if fuse replacement is necessary.

6. Install functional fuse into fuse holder.

7. After fuse testing is complete, install left side cover.

8. Connect the cutting unit power disconnect couplers.

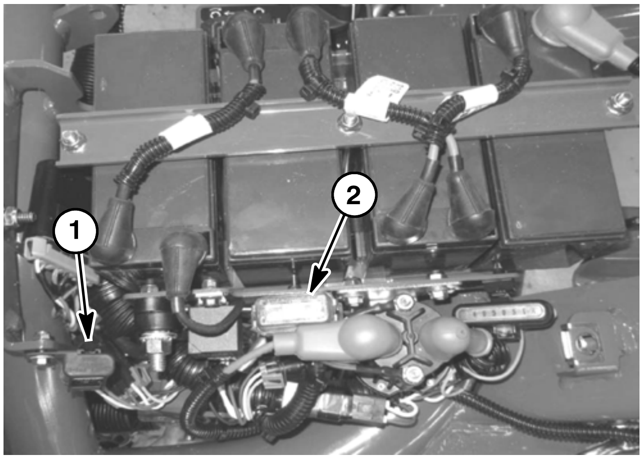


Figure 47

1. **10 amp fuse**
2. **60 amp maxi fuse**

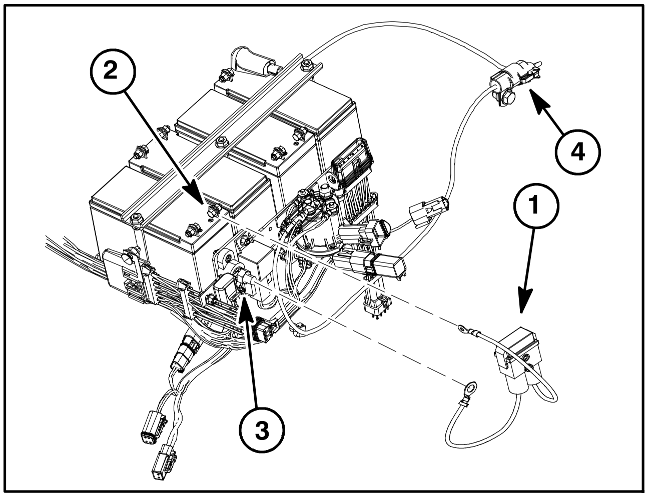


Figure 48

1. **60 amp fuse holder**
2. **Negative (-) terminal**
3. **Junction block**
4. **Disconnect couplers**

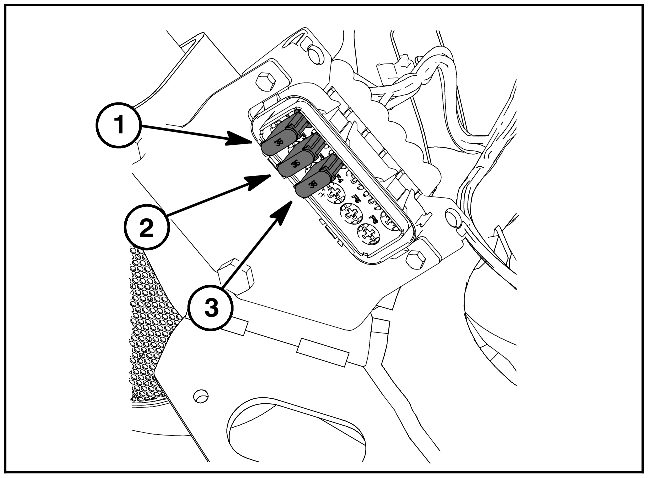


Figure 49

1. **#1 reel motor fuse**
2. **#2 reel motor fuse**
3. **#3 reel motor fuse**

Fusible Links

The electrical system on Greensmaster TriFlex Hybrid machines include a harness with three (3) fusible links for machine circuit protection. This fusible link harness connects the machine wire harness to the positive (+) battery terminal.

Greensmaster 3320 machines (gasoline engine) use only two (2) of the harness fusible links. The fusible link harness on Greensmaster 3320 machines is connected to the starter solenoid (Fig. 50).

Greensmaster 3420 machines (diesel engine) use all three (3) of the harness fusible links. The fusible link harness on Greensmaster 3420 machines is connected to the starter B+ terminal (Fig. 51). Greensmaster 3420 machines use an additional fusible link that is included in the wire harness and connects the starter G terminal to the engine run solenoid pull coil.

If any of these links should fail, current to the protected circuit will cease. Refer to the electrical schematic and wire harness drawings in Chapter 10 – Foldout Drawings for additional circuit information.

Testing

Make sure that ignition switch is OFF. Disconnect negative (–) battery cable from battery terminal and then disconnect positive (+) cable from battery (see Battery Service in the Service and Repairs section of this chapter). Locate fusible link harness and unplug fusible link connector from wire harness. Use a multimeter to make sure that continuity exists between the fusible link terminals. If a fusible link is open, replace the fusible link harness.

After testing is complete, make sure that fusible link is securely attached to engine component and wire harness. Connect positive battery cable to battery terminal first and then connect negative cable to battery.

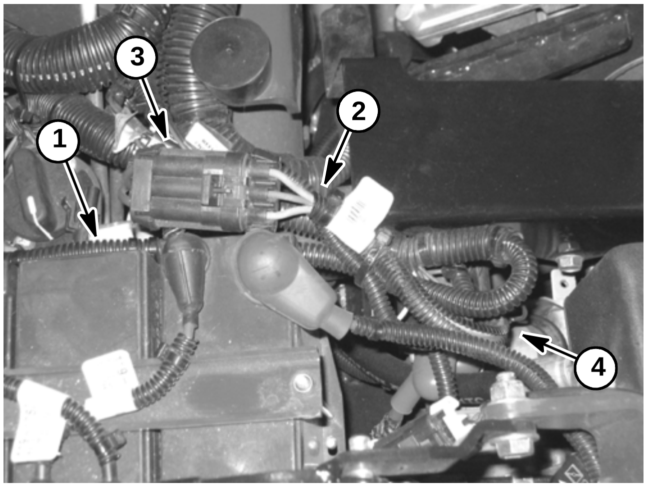


Figure 50

1. **48V battery pack**
2. **Fusible link harness**
3. **Harness connector**
4. **Solenoid location**

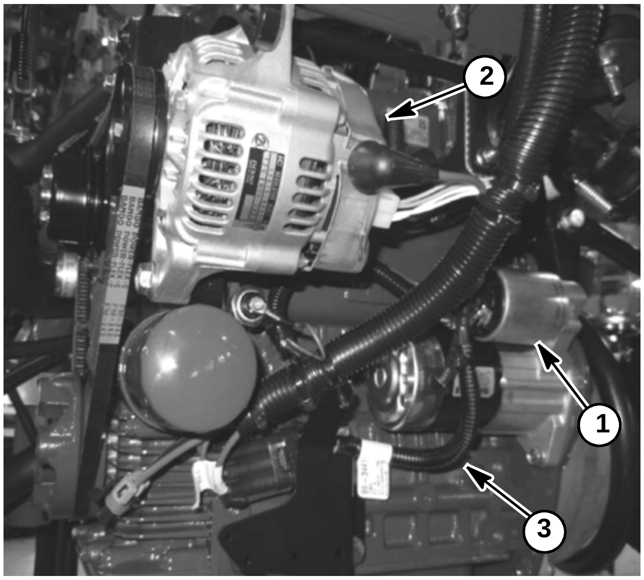


Figure 51

1. **Starter solenoid**
2. **Alternator**
3. **Fusible link harness**

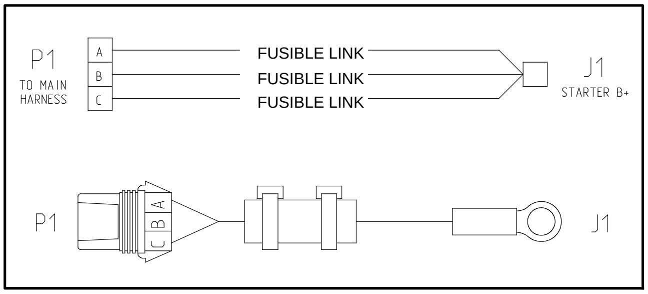


Figure 52

Hour Meter

1. Park machine on a level surface, lower cutting units, engage parking brake and stop engine. Remove key from ignition switch.

2. Remove console cover from console assembly to gain access to hour meter (see Control Console Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

3. Disconnect machine wire harness electrical connector from the hour meter.

4. Connect the positive (+) terminal of a 12 VDC source to the positive terminal of the hour meter.

5. Connect the negative (–) terminal of the voltage source to the other terminal of the hour meter.

6. The hour meter should move 1/10 of an hour in six (6) minutes.

7. Disconnect the voltage source from the hour meter.

8. Replace the hour meter if necessary.

9. Connect harness electrical connector to the hour meter.

10. After testing is complete, connect machine wire harness connector to the hour meter. Secure console cover to machine with removed fasteners.

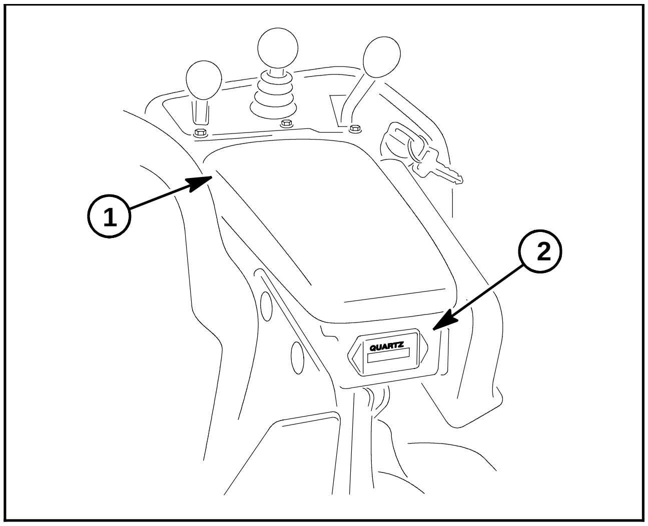


Figure 53

1. **Control console**
2. **Hour meter**

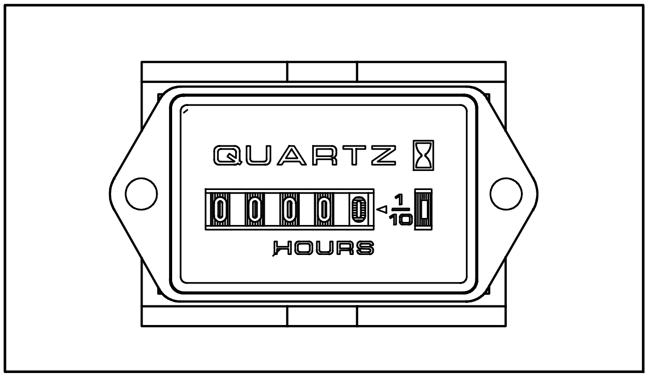


Figure 54

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. If the Functional Control Lever is moved out of neutral (neutral switch opens) and the operator raises out of the seat, the engine will stop. The seat switch and its electrical connector are located directly under the seat (Fig. 55).

Testing

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Before disconnecting the seat switch for testing, the switch and its circuit wiring should be tested as a TEC electrical input using the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter) or InfoCenter Display (see InfoCenter Display in this chapter). If input testing verifies that the seat switch and circuit wiring **are** functioning correctly, no further seat switch testing is necessary. If, however, input testing determines that the seat switch and circuit wiring **are not** functioning correctly, proceed with the following seat switch testing procedure.

3. Make sure ignition switch is in the OFF position.

4. Disconnect seat switch wire harness connector from machine wire harness at rear of operator seat (Fig. 56).

5. Check the continuity of the switch by connecting a multimeter (ohms setting) across the seat switch wire harness connector terminals.

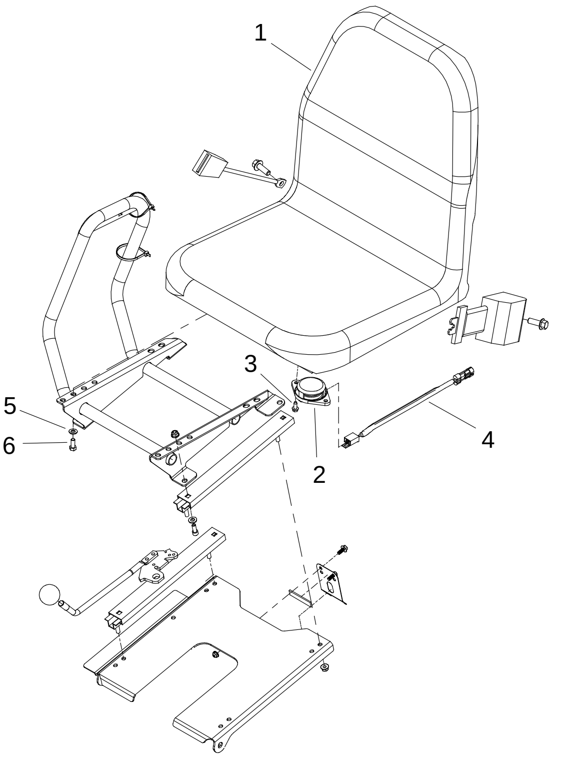
6. With no pressure on the seat, there should be no continuity (open) between the harness terminals.

7. Press directly onto the seat switch through the seat cushion. There should be continuity (closed) between the harness terminals as the seat cushion approaches the bottom of its travel.

8. If continuity checks determine faulty seat switch operation, check seat switch wire harness for problems before replacing seat switch.

9. If the seat switch tests correctly and a circuit problem still exists, check machine wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

10. After seat switch testing is complete, connect seat switch wire harness connector to machine wire harness.



STANDARD SEAT ASSEMBLY SHOWN

Figure 55

1. **Operator seat**
2. **Seat switch**
3. **Cap screw (2 used)**
4. **Seat switch harness**
5. **Flat washer (4 used)**
6. **Cap screw (4 used)**

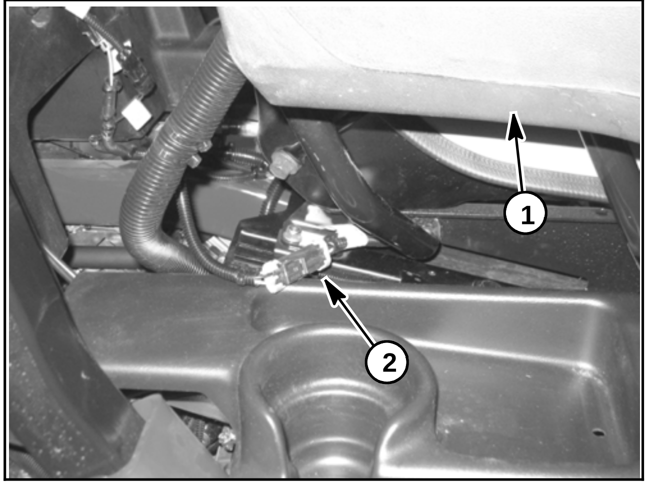


Figure 56

1. **Operator seat**
2. **Seat switch connector**

Neutral and Mow Switches

The neutral and mow switches are normally open proximity switches that mount to the console assembly (Fig. 57). The sensing plate for these switches is a tab on the functional control lever. The Toro Electronic Controller (TEC) monitors the operation of the neutral and mow switches.

When the functional control lever is in the neutral position, the tab on the lever is positioned near the target end of the neutral switch causing the switch to close. The tab on the functional control lever is moved away from the neutral switch when the lever is in either the mow or transport position causing the switch to be in its normal open state.

When the functional control lever is in the mow position, the tab on the lever is positioned near the target end of the mow switch causing the switch to close. The tab on the functional control lever is moved away from the mow switch when the lever is in either the neutral or transport position causing the switch to be in its normal open state.

Testing

1. Park machine on level surface, lower cutting units, stop engine and remove key from ignition switch.

2. Before disconnecting the neutral or mow switch for testing, the switch and its circuit wiring should be tested as a TEC electrical input using the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter) or InfoCenter Display (see InfoCenter Display in this chapter). If input testing verifies that the switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, input testing determines that the switch and circuit wiring **are not** functioning correctly, proceed with the following switch testing procedure.

3. Remove console cover from console assembly to gain access to neutral and mow switches (see Control Console Disassembly in the Service and Repairs section of Chapter 7 – Chassis). Locate switch that is to be tested (Fig. 57).

4. Turn ignition switch to the RUN position (do not start engine) and check LED on cable end of switch.

   A. The neutral switch LED **should be** illuminated **only** when the functional control lever is in the neutral position. The neutral switch LED **should not be** illuminated when the functional control lever is in the either the mow or transport position.

   B. The mow switch LED **should be** illuminated **only** when the functional control lever is in the mow position. The mow switch LED **should not be** illuminated when the functional control lever is in the either the neutral or transport position.

5. If the tested switch LED did not function correctly:

   A. Make sure that switch is properly adjusted (see Neutral and Mow Switches in the Adjustments section of this chapter). If necessary, adjust switch and return to step 4 above.

   B. Make sure ignition switch is OFF and disconnect the switch connector from the machine wire harness.

   C. Using a multimeter, verify that the machine wire harness connector terminal for black wire is closed (continuity) to ground.

   D. Turn ignition switch to the RUN position (do not start engine) and verify with a multimeter that machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

   E. If black wire is closed to ground, pink wire has system voltage present and switch LED did not function correctly (step 4 above), replace tested switch. Adjust switch after installation (see Neutral and Mow Switches in the Adjustments section of this chapter).

6. After switch testing is complete, make sure that switch connector is plugged into machine wire harness. Install console cover (see Control Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

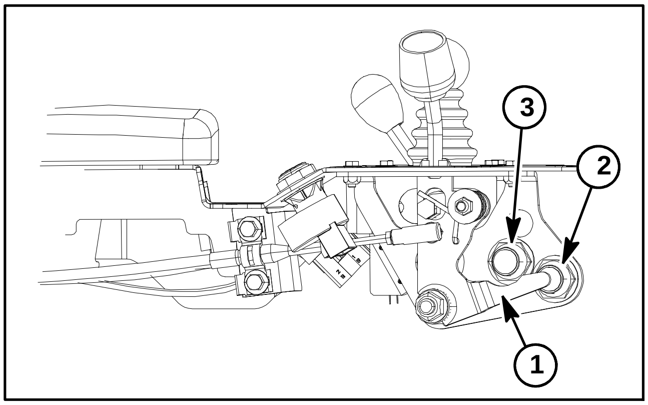


Figure 57

1. **Functional lever tab**
2. **Mow switch**
3. **Neutral switch**

Parking Brake Switch

The parking brake switch is a normally open proximity switch that mounts to the frame bracket used to attach the parking brake lever assembly (Fig. 58). The sensing plate for the brake switch is a tab on the parking brake lever assembly. The Toro Electronic Controller (TEC) monitors the operation of the parking brake switch.

When the parking brake is not applied, the tab on the parking brake lever is positioned near the target end of the parking brake switch so the switch is closed. The tab on the brake lever is moved away from the switch when the parking brake is applied causing the switch to open.

Testing

1. Park machine on level surface, lower cutting units, stop engine and remove key from ignition switch.

2. Before disconnecting the parking brake switch for testing, the switch and its circuit wiring should be tested as a TEC electrical input using the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter) or InfoCenter Display (see InfoCenter Display in this chapter). If input testing verifies that the brake switch and circuit wiring **are** functioning correctly, no further brake switch testing is necessary. If, however, input testing determines that the brake switch and circuit wiring **are not** functioning correctly, proceed with the following parking brake switch testing procedure.

3. Locate parking brake switch. Make sure that parking brake is not applied.

4. Turn ignition switch to the RUN position (do not start engine) and check LED on cable end of parking brake switch. The switch LED **should be** illuminated when the parking brake **is not** applied.

5. With the ignition switch still in the RUN position (do not start engine), apply parking brake and check LED on cable end of brake switch. The switch LED **should not be** illuminated when the parking brake **is** applied.

6. If the brake switch LED did not function correctly:

   A. Make sure that parking brake switch is properly adjusted (see Parking Brake Switch in the Adjustments section of this chapter). If necessary, adjust switch and return to step 4 above.

   B. Make sure ignition switch is OFF and disconnect the parking brake switch connector from the machine wire harness.

   C. Using a multimeter, verify that the machine wire harness connector terminal for black wire is closed (continuity) to ground.

   D. Turn ignition switch to the RUN position (do not start engine) and verify with a multimeter that machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

   E. If black wire is closed to ground, pink wire has system voltage present and switch LED did not function, replace parking brake switch. Adjust switch after installation (see Parking Brake Switch in the Adjustments section of this chapter).

7. After brake switch testing is complete, make sure that switch connector is plugged into machine wire harness.

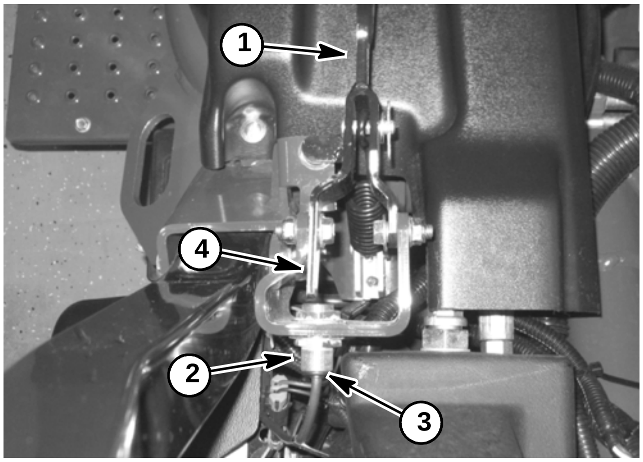


Figure 58

1. **Brake lever**
2. **Parking brake switch**
3. **Switch LED location**
4. **Brake lever tab**

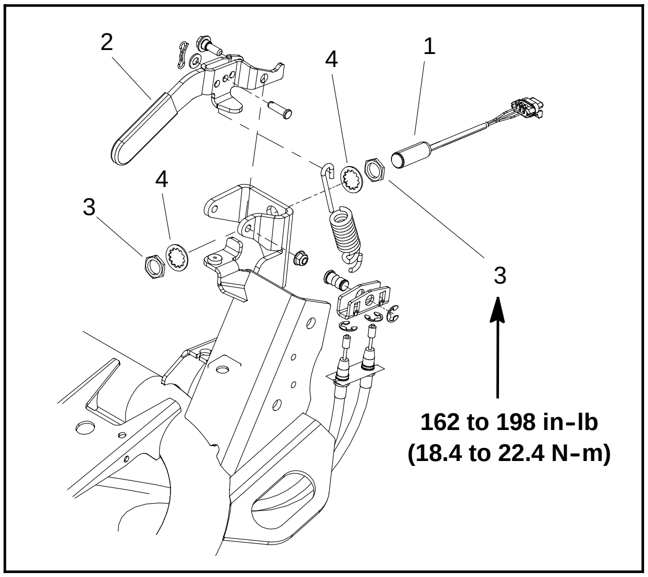


Figure 59

1. **Parking brake switch**
2. **Parking brake lever**
3. **Jam nut (2 used)**
4. **Lock washer (2 used)**

Joystick Raise and Lower Switches

The joystick raise and lower switches are located on the joystick assembly that is attached to the control console. The rear switch is used to lower the cutting units and the front switch to raise them (Fig. 60). The switches are identical and are shown in Figure 61. The Toro Electronic Controller (TEC) monitors the operation of the joystick raise and lower switches.

Testing

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Before disconnecting the joystick switches for testing, the switches and their circuit wiring should be tested as a TEC electrical input using the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter) or InfoCenter Display (see InfoCenter Display in this chapter). If input testing verifies that the joystick switches and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, input testing determines that the joystick switches and circuit wiring **are not** functioning correctly, proceed with the following joystick switch testing procedure.

3. Remove console cover from console assembly to gain access to joystick switches (see Control Console Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

4. Make sure ignition switch is in the OFF position. Disconnect wire harness connectors from joystick switches.

5. Check the continuity of the raise switch by connecting a multimeter (ohms setting) across the switch connector terminals as follows:

   A. With the joystick in the neutral position, continuity should only exist between the common and NC terminals.

   B. With the joystick in the raise position, continuity should only exist between the common and NO terminals.

6. Check the continuity of the lower switch by connecting a multimeter (ohms setting) across the switch connector terminals as follows:

   A. With the joystick in the neutral position, continuity should only exist between the common and NC terminals.

   B. With the joystick in the lower position, continuity should only exist between the common and NO terminals.

7. Replace joystick switch if necessary.

8. After switch testing is completed, connect the harness connectors to the joystick switches. Install console cover (see Control Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

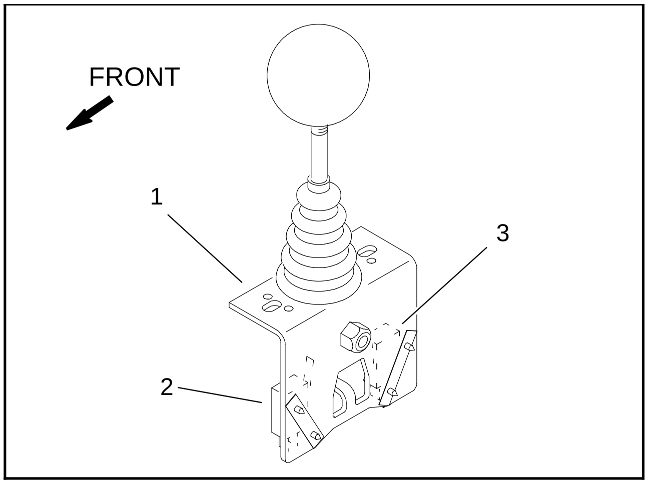


Figure 60

1. **Joystick assembly**
2. **Raise switch**
3. **Lower switch**

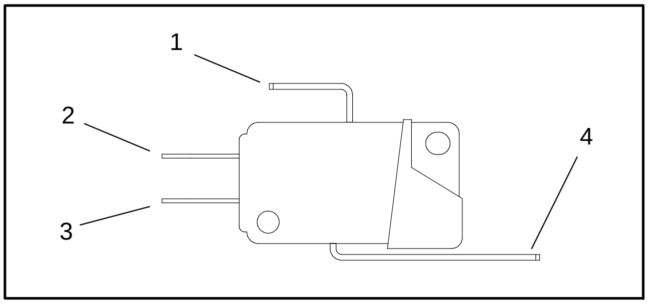


Figure 61

1. **Common terminal**
2. **NO terminal**
3. **NC terminal**
4. **Switch lever**

Backlap Switch

The backlap switch on Greensmaster TriFlex Hybrid machines is used to control cutting reel backlap operation. The Toro Electronic Controller (TEC) uses the backlap switch as an input to reverse cutting reel direction and also to prevent the cutting reels from raising during backlapping. The backlap switch is located under the operator seat (Fig. 62).

The rear of the backlap switch should be depressed for normal mow operation. When the front of the backlap switch is depressed, the machine will be in backlap operation. The indicator light on the switch identifies when the machine is in backlap operation.

Testing

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Before disconnecting the backlap switch for testing, the switch and circuit wiring should be tested as a TEC electrical input using the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter). If input testing verifies that the backlap switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, input testing determines that the backlap switch and circuit wiring **are not** functioning correctly, proceed with the following backlap switch testing procedure.

3. Raise and support operator seat to access backlap switch.

4. Make sure ignition switch is in the OFF position. Disconnect machine wire harness electrical connector from the backlap switch.

5. The backlap switch terminals are identified in Figure 63 and the circuitry of the selector switch is shown in Figure 64. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

6. Replace backlap switch if testing determines that it is faulty.

7. If the backlap switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

8. After testing is complete, connect machine wire harness connector to backlap switch. Lower and secure operator seat.

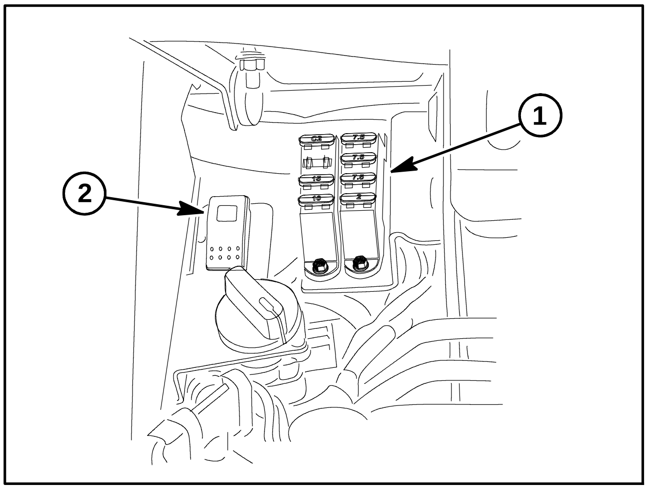


Figure 62

1. **Fuse block**
2. **Backlap switch**

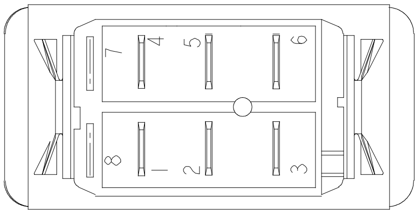


Figure 63

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
MOW	2 + 1	5 + 4
BACKLAP	2 + 3	5 + 6

Figure 64

NOTE: Backlap switch terminals 1, 4, 5 and 6 are not used on Greensmaster TriFlex Hybrid machines.

Electric Reel Contactor

Greensmaster TriFlex Hybrid machines use the electric reel contactor to connect the generator, reel motors and the 48 volt battery pack. The contactor is energized by the generator controller. The electric reel contactor is located under the left side cover next to the operator seat (Fig. 65).

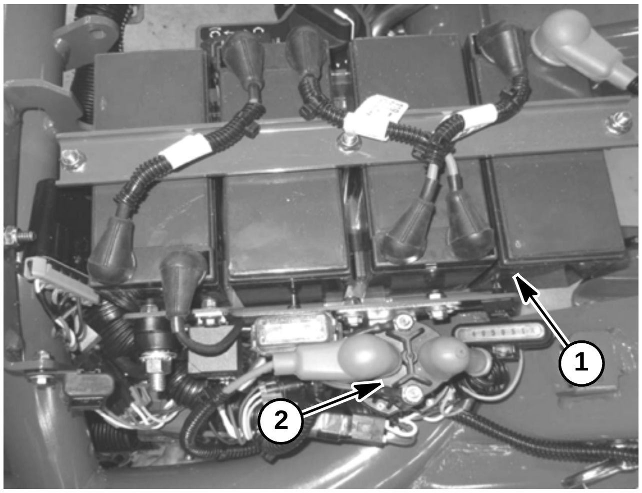


Figure 65

1. **48V battery pack**
2. **Reel contactor**

Testing

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Remove left side cover next to operator seat to allow access to electric reel contactor.

4. Locate contactor and disconnect all wire harness electrical connections from contactor. Note wire connector locations on contactor for assembly purposes.

5. Using jumper wires, apply 48 VDC directly across the contactor coil posts (Fig. 66). The contactor should click as it is energized. With the contactor coil energized, resistance across the main contact posts should be less than **1 ohm**.

6. Remove voltage from contactor coil posts. The contactor should click as it is de–energized. With the contactor coil de–energized, resistance across the main contact posts should be **infinite ohms**.

7. With voltage removed from contactor coil posts, measure resistance across the coil posts (Fig. 66). The coil resistance should be approximately **195 ohms**.

8. If contactor testing determines that contactor is faulty, replace contactor.

9. When contactor testing is complete, connect wire harness electrical connections to contactor.

10. Install left side cover next to operator seat.

11. Connect the cutting unit power disconnect couplers.

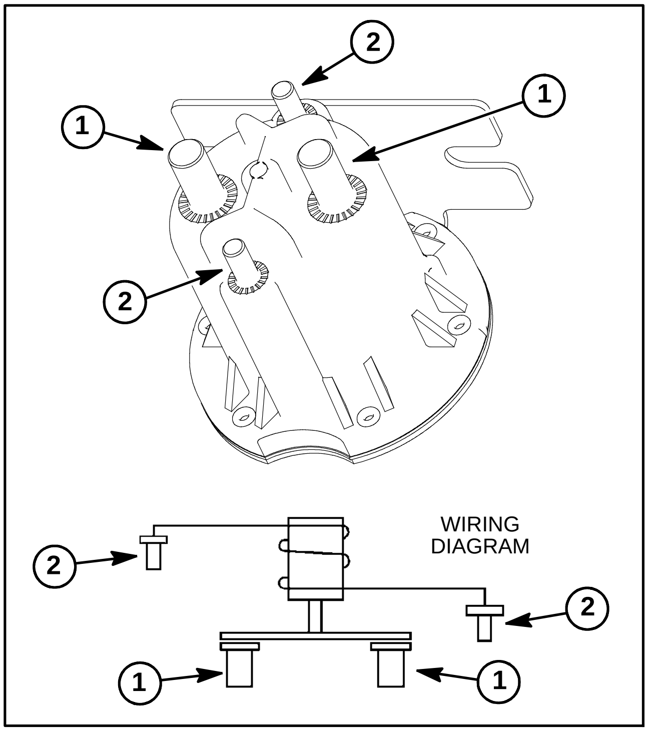


Figure 66

1. **Main contact post**
2. **Coil post**

Reel Speed Potentiometer (Serial Number Below 312000000)

The reel speed potentiometer on Greensmaster TriFlex Hybrid machines with serial number below 312000000 controls the cutting reel speed. The TEC controller uses the potentiometer setting as an input to determine the necessary CAN–bus output to the cutting reel motor controllers for correct cutting reel speed. The reel speed potentiometer is located under the operator seat (Fig. 67).

Testing

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Raise and support operator seat to gain access to reel speed potentiometer.

3. Carefully unplug wire harness connector from reel speed potentiometer.

4. Slide knob from shaft of potentiometer (Fig. 68). Remove screws that secure potentiometer to machine and remove potentiometer from machine for testing.

5. Using a multimeter, measure resistances between potentiometer terminals as follows (Fig. 69):

   A. Verify that resistance between terminals B and C is approximately 5000 ohms. Record measured resistance.

   B. Measure resistance between terminals A and C and then measure resistance between terminals A and B. Record these resistances. The total of the two measured resistances should be approximately 5000 ohms.

   C. Rotate the reel speed potentiometer to other settings and repeat step 6. The total of the two resistances should consistently be approximately 5000 ohms.

   D. If measured resistances are incorrect, replace reel speed potentiometer.

6. After testing is completed, secure potentiometer to machine bracket and slide knob onto potentiometer shaft. Secure wire harness connector to potentiometer. Lower and secure seat.

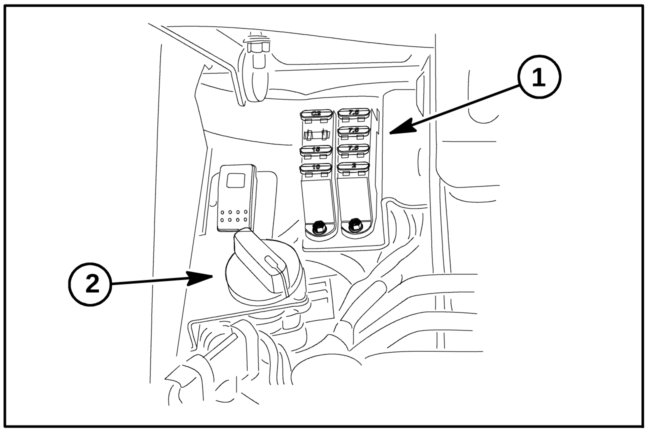


Figure 67

1. **Fuse block**
2. **Potentiometer**

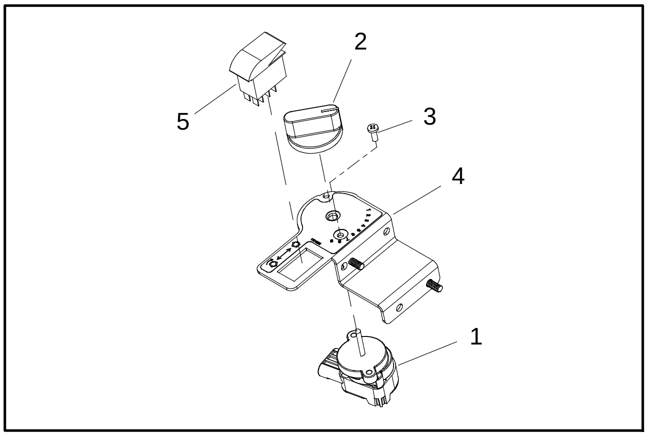


Figure 68

1. **Potentiometer**
2. **Knob**
3. **Screw (2 used)**
4. **Bracket**
5. **Backlap switch**

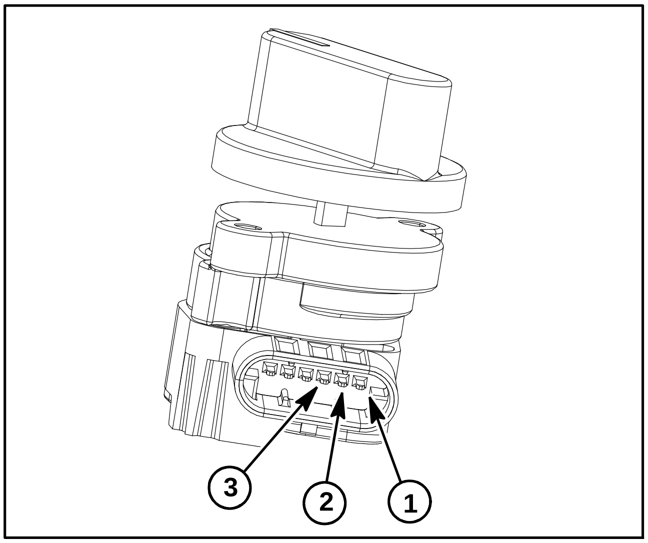


Figure 69

1. **Terminal A**
2. **Terminal B**
3. **Terminal C**

Toro Electronic Controller (TEC)

Greensmaster TriFlex Hybrid machines use a Toro Electronic Controller (TEC) to monitor the condition of various switches (inputs) and then direct electrical power output to allow certain machine functions. The controller is attached to the frame under the operator seat (Fig. 70). TEC inputs and outputs on your Greensmaster can be checked with the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter) or InfoCenter Display (see InfoCenter Display in this chapter).

Inputs from the ignition, neutral, parking brake, seat, joystick, mow, backlap and engine oil pressure are all monitored by the TEC controller. TEC inputs on Greensmaster 3420 machines also include the alternator, engine temperature sender and optional hydraulic temperature sender (if equipped). TEC inputs on Greensmaster 3320 machines also include the leak detector sensor if equipped with the optional Turf Defender^{TM} Leak Detector.

On all Greensmaster TriFlex Hybrid machines, TEC controller current output to the lift circuit hydraulic valve solenoid coils (S1, S2, S3 and S4) and console diagnostic light (if equipped) are controlled based on the inputs received by the controller. TEC outputs on Greensmaster 3320 machines also include the start solenoid, fuel solenoid, charge circuit relay, kill relay and optional Turf Defender^{TM} Leak Detector indicator light and alarm. TEC outputs on Greensmaster 3420 machines also include the start relay, glow relay, fuel pump, engine run solenoid (hold coil), fan relay and console indicator lights (if equipped).

If the controller detects a malfunction in any of the controlled circuits, the diagnostic light or InfoCenter Display can be used to identify the fault.

The diagram in Figure 71 depicts the connection terminal functions of the TEC controller. A fifty (50) pin wire harness connector attaches to the controller. The connector pins are listed in the diagram. Note that electrical power for controller outputs is provided through three (3) connectors each protected with a 7.5 amp fuse.

Because of the solid state circuitry built into the controller, there is no method to test it directly. The controller may be damaged if an attempt is made to test it with an electrical test device, such as a digital multimeter.

IMPORTANT: Before welding on the machine, disconnect both battery cables from the battery, disconnect the wire harness connector from the TEC controller and disconnect the terminal connector from the alternator. This will prevent damage to the electrical system of your Greensmaster.

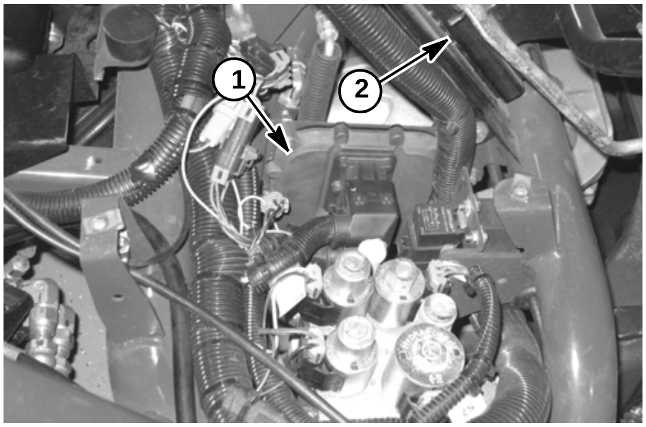


Figure 70

1. **TEC controller location**
2. **Seat platform**

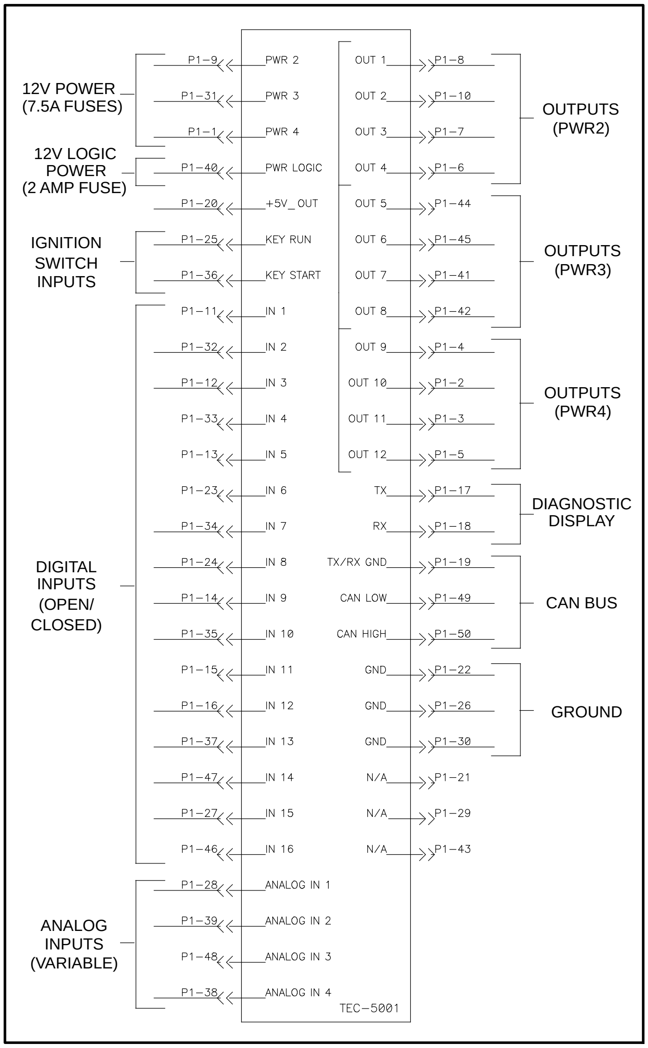

12V POWER (7.5A FUSES)
12V LOGIC POWER (2 AMP FUSE)
IGNITION SWITCH INPUTS
DIGITAL INPUTS (OPEN/ CLOSED)
ANALOG INPUTS (VARIABLE)
P1-9 PWR 2
P1-31 PWR 3
P1-1 PWR 4
P1-40 PWR LOGIC
P1-20 +5V_ OUT
P1-25 KEY RUN
P1-36 KEY START
P1-11 IN 1
P1-32 IN 2
P1-12 IN 3
P1-33 IN 4
P1-13 IN 5
P1-23 IN 6
P1-34 IN 7
P1-24 IN 8
P1-14 IN 9
P1-35 IN 10
P1-15 IN 11
P1-16 IN 12
P1-37 IN 13
P1-47 IN 14
P1-27 IN 15
P1-46 IN 16
P1-28 ANALOG IN 1
P1-39 ANALOG IN 2
P1-48 ANALOG IN 3
P1-38 ANALOG IN 4
OUT 1 P1-8
OUT 2 P1-10
OUT 3 P1-7
OUT 4 P1-6
OUT 5 P1-44
OUT 6 P1-45
OUT 7 P1-41
OUT 8 P1-42
OUT 9 P1-4
OUT 10 P1-2
OUT 11 P1-3
OUT 12 P1-5
TX P1-17
RX P1-18
TX/RX GND P1-19
CAN LOW P1-49
CAN HIGH P1-50
GND P1-22
GND P1-26
GND P1-30
N/A P1-21
N/A P1-29
N/A P1-43
OUTPUTS (PWR2)
OUTPUTS (PWR3)
OUTPUTS (PWR4)
DIAGNOSTIC DISPLAY
CAN BUS
GROUND
TEC-5001

Figure 71

Hydraulic Solenoid Valve Coils

The Greensmaster hydraulic control manifolds use several hydraulic solenoid valve coils for system control. The lift manifold includes four (4) solenoid valves. On machines equipped with the optional Turf Guardian^{TM} Leak Detector, the leak detector manifold includes a single solenoid valve. When the solenoid coils are energized, hydraulic valve shift occurs to control hydraulic circuit flow. Testing of the coils can be done with the coil installed on the hydraulic valve.

Testing

NOTE: Before disconnecting and testing solenoid valve coils, test the TEC controller outputs with the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter) or InfoCenter Display (see InfoCenter Display in this chapter). If the Diagnostic or InfoCenter Display verifies that the TEC outputs **are** functioning correctly, consider that a problem with the solenoid valve coil or circuit wiring may exist. An open or shorted controller output (e.g. a failed solenoid valve coil, an unplugged connector or a broken wire) cannot be detected with the Diagnostic or InfoCenter Display. Conversely, if the Diagnostic or InfoCenter Display verifies that the TEC outputs **are not** functioning correctly, consider that a problem with controller inputs, controller fuses or the TEC controller may exist.

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Determine solenoid coil(s) that are to be tested and locate coil on correct hydraulic manifold:

   A. Remove right side cover next to operator seat to allow access to lift control manifold.

   B. To gain access to leak detector manifold, see Leak Detector Solenoid Valve Assembly in the Service and Repairs section of Chapter 5 – Hydraulic System.

3. Disconnect harness electrical connector from hydraulic solenoid valve coil that is to be tested (Fig. 72 or 73).

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter may display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the solenoid coil being testing.

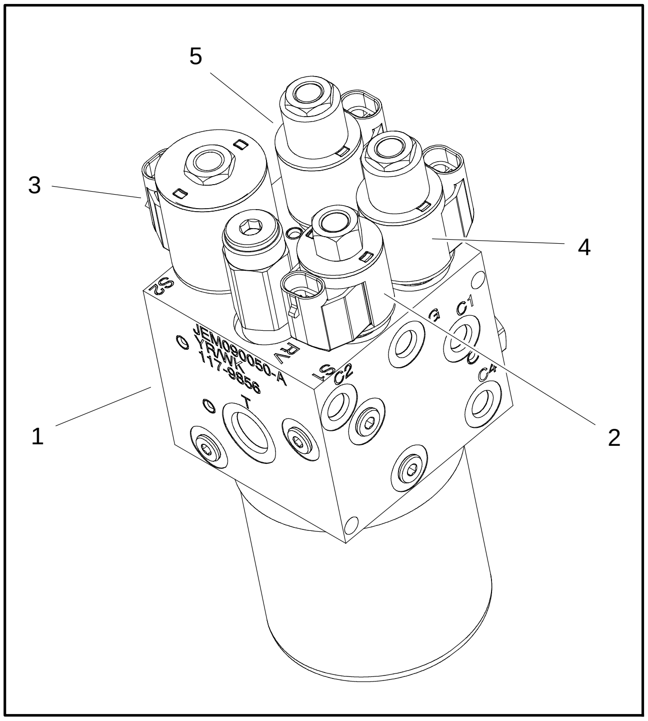


Figure 72

1. **Hydraulic lift manifold**
2. **Solenoid valve S1**
3. **Solenoid valve S2**
4. **Solenoid valve S3**
5. **Solenoid valve S4**

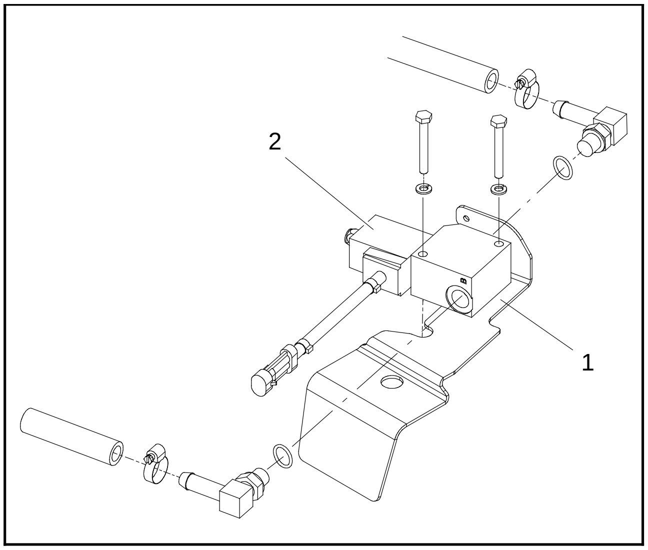


Figure 73

1. **Leak detector manifold**
2. **Solenoid valve**

NOTE: Solenoid coil resistance should be measured with solenoid at approximately 68°F (20°C). Resistance may be slightly different than listed at different temperatures. Typically, a failed solenoid coil will either be shorted (very low or no resistance) or open (infinite resistance).

4. Using a multimeter (ohms setting), measure resistance between the two (2) connector terminals on the solenoid valve coil. The resistance for the solenoid coils is identified below:

Solenoid Valve Coil	Resistance
S1, S3 and S4 (lift)	8.8 ohms
S2 (lift)	7.1 ohms
Leak Detector	7.2 ohms

5. If solenoid coil resistance is incorrect, replace solenoid (refer to appropriate control manifold service procedures in the Service and Repairs section of Chapter 5 – Hydraulic System).

NOTE: The lift manifold S1, S3 and S4 coils are identical. To assist in troubleshooting, identical solenoid valve coils can be exchanged. If the problem follows the exchanged coil, an electrical problem likely exists with the coil. If the problem remains unchanged, something other than the solenoid coil is the problem source (e.g. switch, circuit wiring, hydraulic problem).

6. After coil testing is completed, connect wire harness electrical connector to the solenoid valve coil.

7. Secure all machine components that were removed to access hydraulic manifold.

Main Power, Electric Cutting Reels Enable, Charge Circuit (Greensmaster 3320), Glow (Greensmaster 3420) and Fan (Greensmaster 3420) Relays

The Greensmaster TriFlex Hybrid electrical system includes several identical, four (4) terminal relays for current control. Most of these relays are located under the right side cover next to the operator seat (Fig. 74). The electric cutting reels enable relay is located under the left side cover next to the operator seat (Fig. 75). Relays can be identified by a tag near the relay wire harness connector.

The main power relay provides electrical current to the fuse blocks when energized by the ignition switch in the RUN or START position. The main power relay is used on both Greensmaster 3320 and 3420 machines.

The electric cutting reels enable relay is used to provide 48V logic power to the generator and reel motor controllers. It also supplies power to the main contactor in the electric reel circuit. This relay is energized by an output from the TEC controller. The reels enable relay is used on both Greensmaster 3320 and 3420 machines.

The charge circuit relay used on Greensmaster 3320 machines provides a current path for alternator output to reach the machine's electrical system. The charge circuit relay is energized by the Toro Electronic Controller (TEC) when the ignition switch is in RUN or START.

The glow relay used on Greensmaster 3420 machines provides electrical current to the engine glow plugs when energized by the TEC controller.

The fan relay used on Greensmaster 3420 machines provides electrical current to the engine cooling fan when energized by the TEC controller. The fan relay is energized when engine coolant temperature reaches approximately 185^{o}F (85^{o}C).

The reels enable relay, charge circuit, glow and fan relays along with their circuit wiring **should** be tested as a TEC controller output with the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter) or InfoCenter Display (see InfoCenter Display in this chapter) before disconnecting and testing the relay.

Testing

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch. Remove right side cover next to operator seat to allow access to relays.

2. Make sure ignition switch is in the OFF position. Locate the relay to be tested and disconnect wire harness electrical connector from relay. Remove relay from bracket for easier testing.

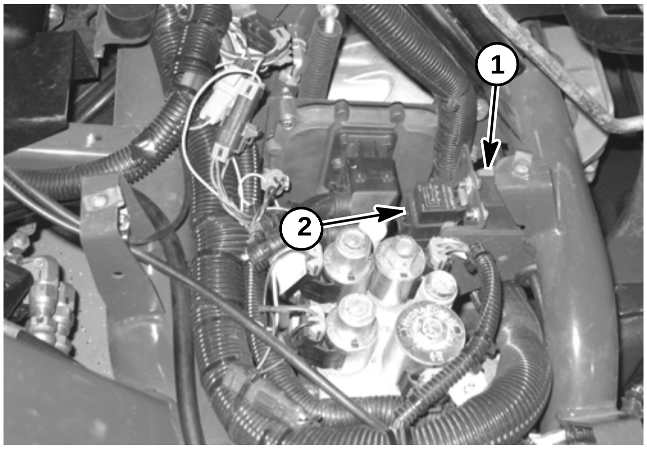


Figure 74

1. **Relay (4 terminal)**
2. **Relay (5 terminal)**

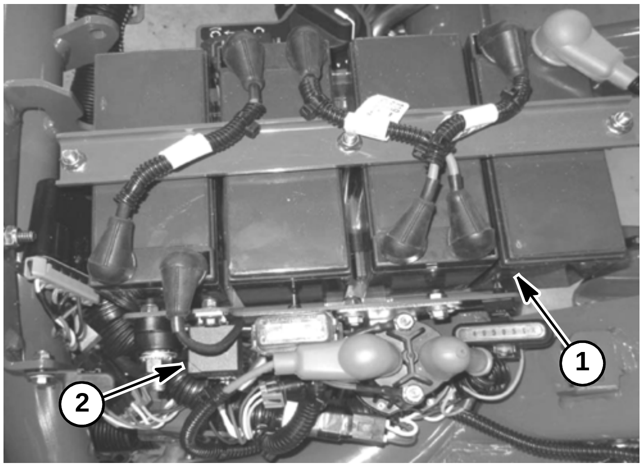


Figure 75

1. **48V battery pack**
2. **Reels enable relay**

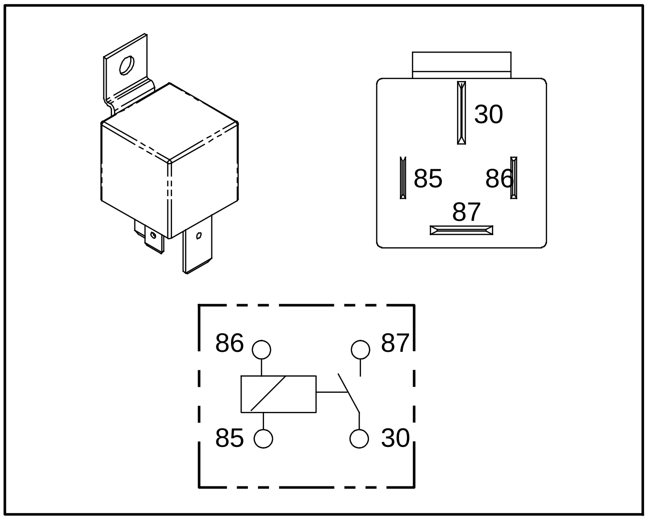


Figure 76

3. Measure coil resistance between terminals 85 and 86 with a multimeter (ohms setting) (Fig. 76). Resistance should be approximately **72 ohms**.

4. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

5. Disconnect voltage and leads from the relay terminals. Replace relay if necessary.

6. After testing is completed, secure relay to bracket and connect wire harness electrical connector to relay.

7. Install right side cover next to operator seat.

Kill (Greensmaster 3320) and Start (Greensmaster 3420) Relays

The Greensmaster TriFlex Hybrid electrical system includes a five (5) terminal relay for current control. The kill relay is used only on Greensmaster 3320 machines. The start relay is used only on Greensmaster 3420 machines. These relays are located under the right side cover next to the operator seat (Fig. 77) and can be identified by a tag near the relay wire harness connector.

When energized by the TEC controller, the kill relay on Greensmaster 3320 machines provides a grounding path for the engine starter solenoid. While energized, the kill relay also allows the engine magneto (ignition) system to function. When the kill relay is de–energized, a grounding path is made for the engine magneto armatures to prevent ignition function and stop the engine.

The start relay on Greensmaster 3420 machines provides electrical current to the engine starter solenoid when energized by the TEC controller.

Testing

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch. Remove right side cover next to operator seat to allow access to relays.

2. Locate relay to be tested and disconnect the machine wire harness connector from the relay. Remove relay from bracket for easier testing.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the relay being testing.

3. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 78). Resistance should be between **70 and 90 ohms**.

4. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay terminals 30 and 87 should have continuity as +12 VDC is applied to terminal 85. The relay terminals 30 and 87 should not have continuity as +12 VDC is removed from terminal 85.

5. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.

6. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. With terminal 86 grounded, apply +12 VDC to terminal 85. The relay terminals 30 and 87A should not have continuity as +12 VDC is applied to terminal 85. The relay terminals 30 and 87A should have continuity as +12 VDC is removed from terminal 85.

7. When relay testing is completed, disconnect voltage and multimeter leads from the relay terminals. Replace relay if necessary.

8. Secure relay to machine and connect machine wire harness connector to relay.

9. Install right side cover next to operator seat.

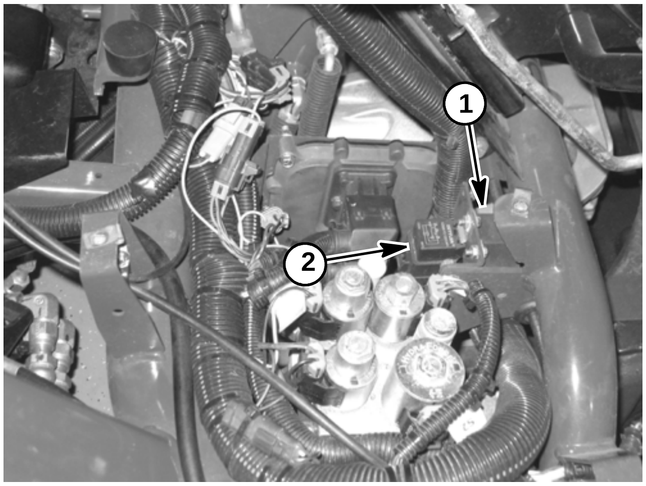


Figure 77

1. **Relay (4 terminal)**
2. **Relay (5 terminal)**

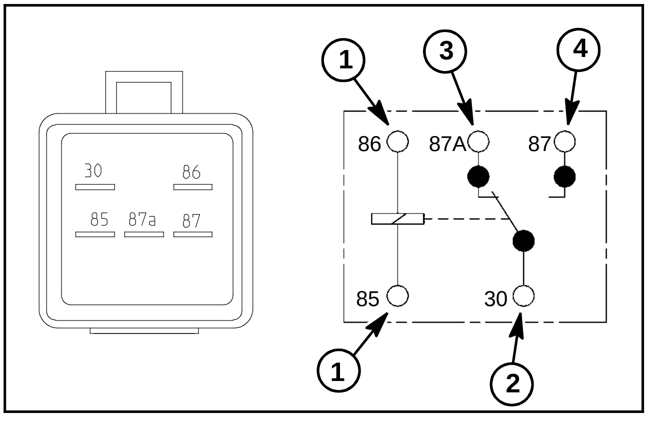


Figure 78

1. **Coil terminal**
2. **Common terminal**
3. **Normally closed term.**
4. **Normally open term.**

CAN-bus Termination Resistors

System communication between electrical components on Greensmaster Hybrid TriFlex machines is accomplished on two (2) CAN-bus communication systems. Two (2) specially designed, twisted cables form the bus for both of the networks used on the Hybrid machines. These wires provide the data pathways between machine components. At the ends of the twisted pair of bus cables are 120 ohm termination resistors.

The resistors plug into the wire harness in the following areas:

A. The two (2) termination resistors for the main electrical system on Greensmaster machines are located near the hydraulic lift control manifold under the right side cover next to the operator seat.

B. The two (2) termination resistors for the E-Reels electrical circuit are located near the wire harness connectors for the RH and LH cutting reel motors.

NOTE: Refer to the Electrical Schematics and Wire Harness Drawings in Chapter 10 - Foldout Drawings for additional information on termination resistor locations and wire connections.

IMPORTANT: The termination resistors at the ends of the bus cables are required for proper electrical system operation.

Termination Resistor Test

The termination resistors (Fig. 79) can be individually tested using a digital multimeter (ohms setting). Locate resistor and remove cable tie that secures resistor to wire harness. Unplug the resistor from the wire harness for testing.

NOTE: The insulator wedge in the termination resistor is blue for identification purposes. There also is a center keyway to prevent the termination resistor from plugging into the wrong wire harness connector.

Use a digital multimeter (ohms setting) to measure the resistance value for the termination resistor. There should be **120 ohms** resistance between terminals A and B. Refer to Fig. 79 to determine terminal locations. Terminal C is not used on Greensmaster Hybrid TriFlex machines.

If testing determines that termination resistor is faulty, replace resistor.

After testing is complete, make sure that termination resistor is fully installed into wire harness connector and secured to wire harness with cable tie.

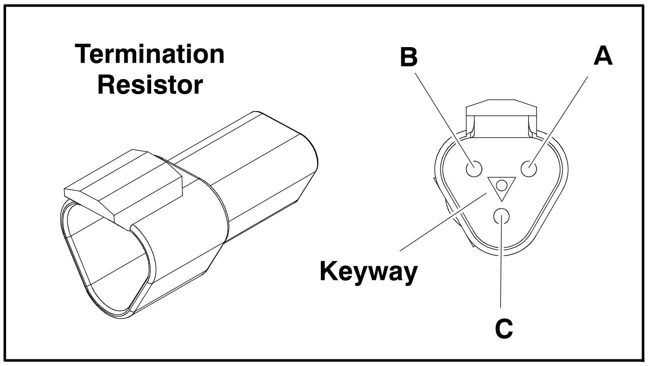


Figure 79

Electric Reel Circuit Protection Diode

The Greensmaster TriFlex Hybrid electric reel circuit includes a diode that is used for circuit protection from voltage spikes when the electric reel contactor is de- energized. The diode plugs into the E- Reels wire harness under the left side cover next to the operator seat (Fig. 80).

Protection Diode Test

The protection diode (Fig. 81) can be tested using a digital multimeter (diode test or ohms setting) and the table to the right.

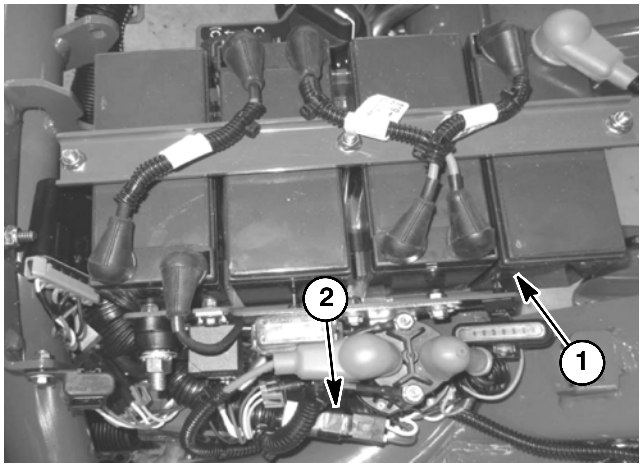


Figure 80

1. **48V battery pack**
2. **Protection diode**

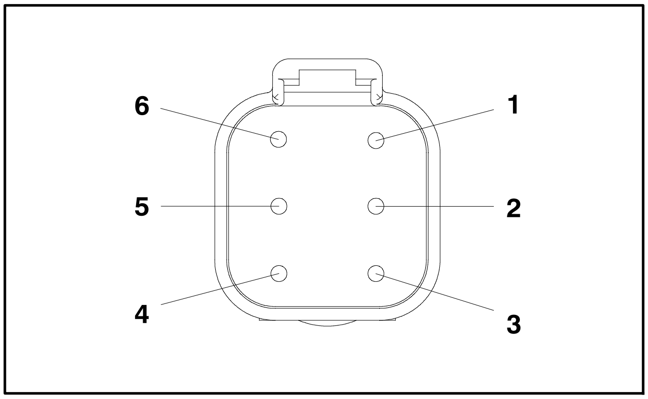


Figure 81

Multimeter Red Lead (+) on Terminal	**Multimeter Black Lead (-) on Terminal**	**Continuity**
6	1	YES
1	6	NO

Location ID Module

The location ID module exists in the electric cutting reels circuit to identify the location of the three (3) cutting reel motors. This module allows such machine features as raising the center cutting unit slightly later than the front cutting units. The location module plugs into the E-Reels wire harness under the left side cover next to the operator seat (Fig. 82).

Testing

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch. Remove right side cover next to operator seat to allow access to location ID module.

2. Carefully unplug E-Reels wire harness connector from location ID module connector.

NOTE: Location ID module connector terminals A and B are not used on Greensmaster TriFlex Hybrid machines.

3. Using a multimeter, measure resistances between module connector terminals as follows (Fig. 83). If any of the measured resistances vary by more than 10%, replace location ID module.

Connector Terminals	Resistance
C and F	6.2 K ohms
D and F	3.9 K ohms
E and F	1.6 K ohms

NOTE: A quick check of the electric reel motors and the E-Reels wire harness can be done while the wire harness connector is disconnected from the ID module. Using a multimeter, measure the resistances between the wire harness ID module connector terminals C and F for right reel motor (#3), D and F for left reel motor (#2) and E and F for center reel motor (#1). Resistance should be approximately **18.8 K-ohms** for all combinations. An incorrect resistance measurement would suggest a faulty reel motor or damage to the E-Reels wire harness.

4. After testing is completed, secure wire harness connector to location ID module connector. Install right side cover next to operator seat.

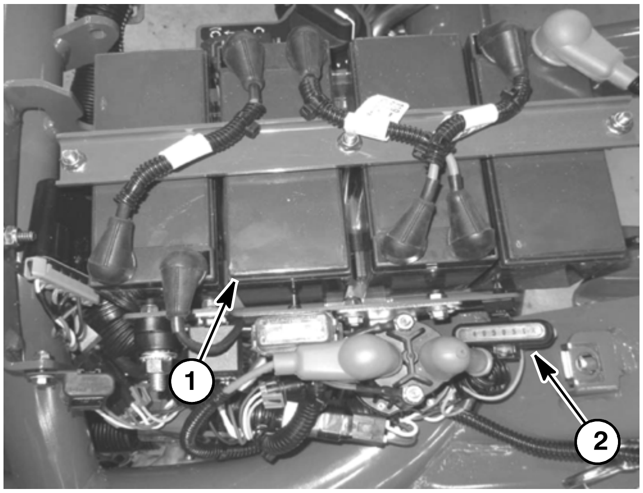


Figure 82

1. **48V battery pack**
2. **Location ID module**

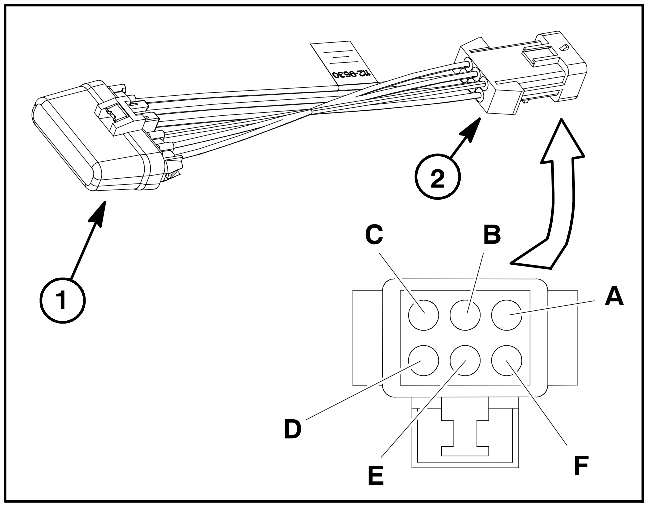


Figure 83

1. **Location ID module**
2. **Module connector**

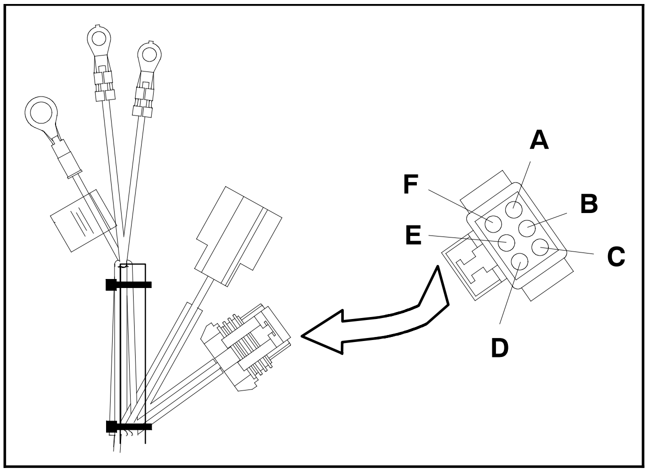


Figure 84

1. **E-Reels wire harness**
2. **ID module connector**

Cutting Reel Motors

The three (3) cutting reel motors are identical 48 VDC, brushless, permanent magnet motors. Each motor has its own integral invertor and on-board controller.

Because the cutting reel motors used on the machine are identical, motors from different cutting units can be exchanged. If the problem follows a motor to the new cutting unit, the motor is likely the issue. If the problem remains with the cutting unit, the issue is likely due to the cutting unit, electrical components or wiring to that cutting unit.

NOTE: Before considering that cutting reel motor service work is necessary, check for any existing fault codes that indicate problems with a reel motor (see Fault Codes in the Troubleshooting section of this chapter). If a cutting reel motor is faulty, there will likely be numerous fault codes that are listed by the InfoCenter display.

Testing

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Separate system components from the 48 VDC battery pack by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Locate cutting reel motor cable electrical connections at machine wire harness for motor that is to be tested.

IMPORTANT: When disconnecting reel motor cable connectors, take care to not damage the cable or connectors. The reel motor cable is not available as a separate replacement part.

4. Carefully disconnect two (2) reel motor cable connectors from machine wire harness (Fig. 85).

5. Using a multimeter, measure resistance between 48 VDC ground terminal (black wire) in the 2 wire connector and location ID terminal (blue wire) in 4 wire connector (Fig. 86). Resistance should be approximately **18.8 K-ohms**.

6. If measured resistance is incorrect, consider that the cutting reel motor is faulty.

NOTE: If cutting reel motor removal, installation, disassembly or assembly information is needed, see Cutting Reel Motor and Cutting Reel Motor Service in the Service and Repairs section of this chapter.

7. After testing is completed, secure two (2) reel motor cable connectors to machine wire harness connectors.

8. Connect the cutting unit power disconnect couplers together before operating the machine.

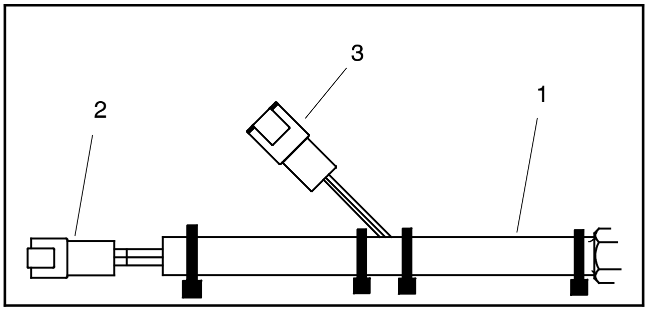


Figure 85

1. **Cable from motor**
2. **4 wire connector**
3. **2 wire connector**

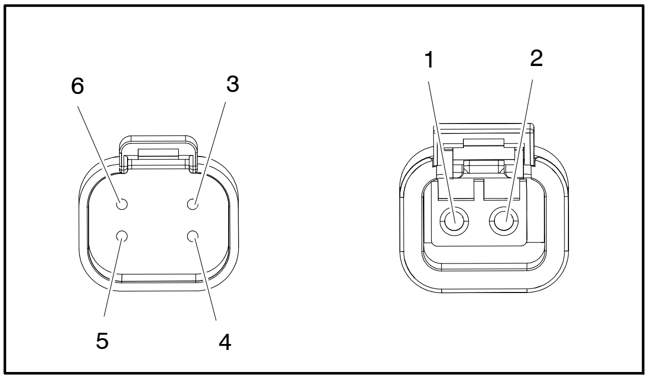


Figure 86

1. **48 VDC power (red)**
2. **48 VDC ground (black)**
3. **48 VDC logic (white)**
4. **Location ID (blue)**
5. **CAN Low (yellow)**
6. **CAN High (green)**

Starter Solenoid (Greensmaster 3320)

The starter solenoid used on Greensmaster 3320 machines allows current flow from the battery to the engine starter motor when energized. This solenoid is energized by the TEC controller when the ignition switch is in the START position. The starter solenoid is attached to the left side of the rear frame beneath the hydraulic oil reservoir (Fig. 87).

Testing

NOTE: Before disconnecting and testing starter solenoid, test the TEC controller outputs with the Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter) or InfoCenter Display (see InfoCenter Display in this chapter). If the Diagnostic or InfoCenter Display verifies that the TEC outputs **are** functioning correctly, consider that a problem with the starter solenoid or circuit wiring may exist. An open or shorted controller output (e.g. a failed starter solenoid, an unplugged connector or a broken wire) cannot be detected with the Diagnostic or InfoCenter Display. Conversely, if the Diagnostic or InfoCenter Display verifies that the TEC outputs **are not** functioning correctly, consider that a problem with controller inputs, controller fuses or the TEC controller may exist.

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Disconnect negative (black) cable from battery and then disconnect positive (red) cable (see Battery Service in the Service and Repairs section of this chapter).

3. Note wire locations on starter solenoid for assembly purposes. Disconnect cables and wire harness connectors from solenoid.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

4. Apply 12 VDC directly across the solenoid coil posts (steel). The solenoid should click as the solenoid coil is energized. Make sure resistance across the main contact posts (copper) is less than **1 ohm**.

5. Remove voltage from solenoid coil posts (steel). The solenoid should click as the solenoid coil is de-energized. Make sure resistance across the main contact posts (copper) is **infinite ohms**.

6. Resistance across the solenoid coil posts (steel) should be approximately **13.5 ohms**.

7. Replace starter solenoid if necessary.

8. Connect positive battery cable to one main contact post on starter solenoid, starter cable to the other main contact post and two (2) wire harness connectors to solenoid posts.

9. Connect battery cables to battery. Make sure to connect positive (red) battery cable first and then connect negative (black) cable.

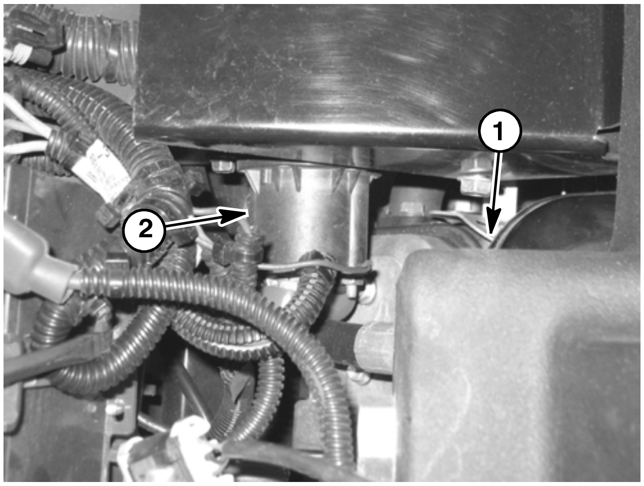


Figure 87

1. **Hydraulic reservoir**
2. **Starter solenoid**

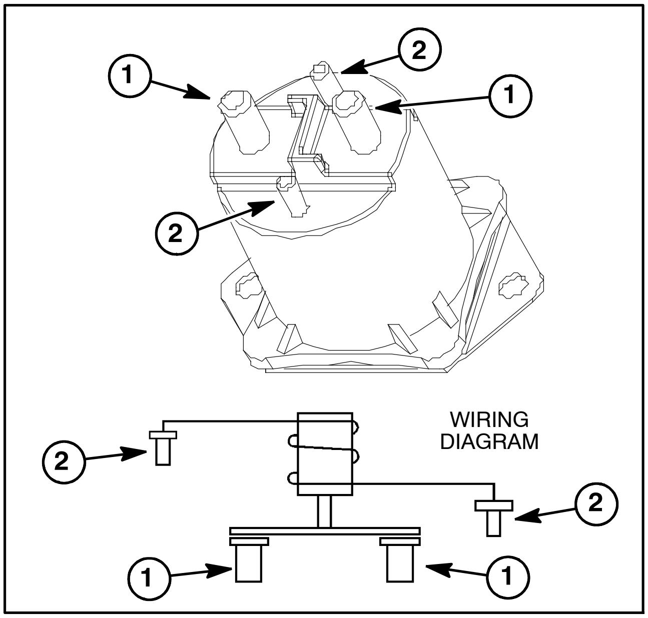


Figure 88

1. **Main posts (copper)**
2. **Solenoid posts (steel)**

Fuel Pump (Greensmaster 3420)

The fuel pump on Greensmaster 3420 machines is secured to the radiator assembly with an r- clamp (Fig. 89). The Toro Electronic Controller (TEC) energizes the fuel pump when the ignition switch is in either the RUN or START position.

IMPORTANT: When testing fuel pump, make sure that pump is not operated without fuel.

DANGER

Because diesel fuel is flammable, use caution when handling it. Do not smoke while testing the fuel pump. Do not test fuel pump while engine is hot. Make sure that there is adequate ventilation when testing. Always wipe up any spilled fuel before starting the engine.

Fuel Pump Capacity Test

1. Park machine on a level surface, lower cutting units, stop engine and engage parking brake.

2. Disconnect machine fuel supply hose from the fuel pump outlet (Fig. 89).

3. Make sure fuel hose attached to the fuel pump inlet is free of obstructions. Also, make sure that fuel shut- off valve on fuel tank is open.

4. For fuel pump testing, place section of fuel hose on fuel pump outlet and secure in place with hose clamp. Place other end of fuel hose into a large, graduated cylinder sufficient enough to collect 1 quart (0.95 liter).

IMPORTANT: When testing the fuel pump, DO NOT turn ignition switch to START.

5. Collect fuel in the graduated cylinder by turning ignition switch to the RUN position. Allow pump to run for fifteen (15) seconds, then turn ignition switch to OFF.

6. Fuel collected in the graduated cylinder should be approximately 16 fl oz (475 ml) after fifteen (15) seconds.

7. Replace fuel pump if necessary.

8. Remove fuel hose from pump outlet and install machine fuel supply hose to the pump outlet. Make sure to secure fuel hose with hose clamp.

9. Bleed the fuel system.

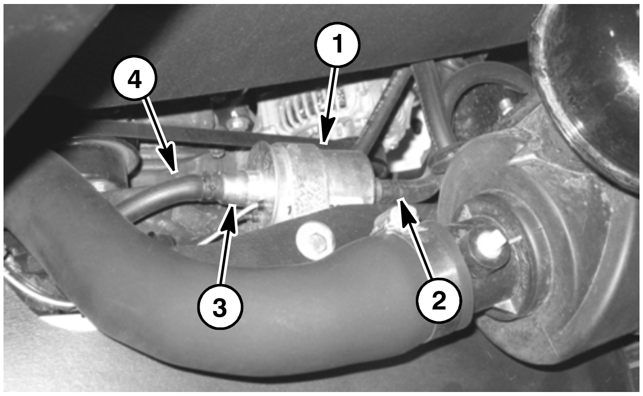


Figure 89

1. **Fuel pump**
2. **Fuel pump inlet**
3. **Fuel pump outlet**
4. **Fuel supply hose**

Fuel Pump Specifications

Pump Capacity	64 fl oz/min (1.9 l/min)
Pressure	7 PSI (48.3 kPa)
Current Draw	2.0 amp

Fuel Solenoid (Greensmaster 3420)

The fuel solenoid used on Greensmaster 3420 machines must be energized for the diesel engine to run. The fuel solenoid is mounted to the injection pump on the engine (Fig. 90). The Toro Electronic Controller (TEC) energizes the fuel solenoid when the ignition switch is in either the RUN or START position.

The fuel solenoid includes two (2) coils for operation: the pull coil and the hold coil. When the ignition switch is turned to START, the fuel solenoid pull coil is energized and the solenoid plunger retracts. Once the plunger is retracted, the hold coil will keep it retracted for continued engine operation. When the solenoid is de- energized, the plunger extends to shut off fuel supply to the engine causing the engine to stop running.

NOTE: A fusible link in the machine wire harness protects the fuel solenoid pull coil circuit. If this link should fail, the fuel solenoid will not function and the engine will not run. Refer to electrical drawings in Chapter 10 - Foldout Drawings when troubleshooting the fuel solenoid.

NOTE: See Kubota Workshop Manual, Diesel Engine, SM- E3B Series for information regarding fuel solenoid testing procedure.

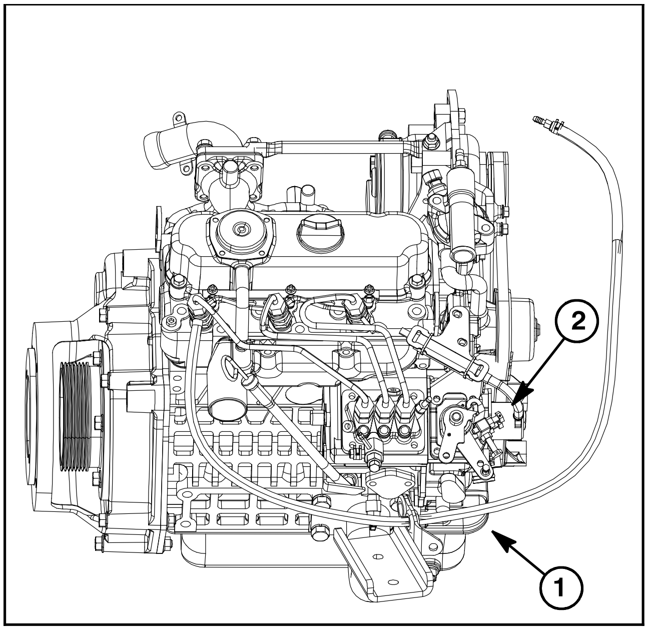


Figure 90

1. **Engine assembly**
2. **Fuel solenoid**

Temperature Sender (Greensmaster 3420)

The temperature sender is located near the alternator on the water flange attached to the engine cylinder head (Fig. 91).

The resistance of the temperature sender reduces as the engine coolant temperature increases. The changing resistance of the temperature sender signals the console temperature gauge to indicate engine coolant temperature during machine operation.

Temperature Sender Test

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Locate temperature sender on engine and disconnect wire harness connector from sender.

CAUTION

Make sure engine is cool before removing the temperature sender from engine.

3. Lower coolant level in the engine and remove the temperature sender from water flange.

4. Put sender in a container of oil with a thermometer and slowly heat the oil (Fig. 92).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

NOTE: Prior to taking resistance readings with a digital multi meter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less) due to the internal resistance of the meter and test leads. Subtract this value from from the measured value of the component you are testing.

5. Check resistance of the sender with a multimeter (ohms setting) as the oil temperature increases.

OIL TEMP	TEMP SENDER RESISTANCE
68°F (20°C)	11.4 to 13.6 10K ohms
140°F (60°C)	2.3 to 2.6 10K ohms
212°F (100°C)	0.6 to 0.7 10K ohms

6. Replace temperature sender if specifications are not met.

7. Install temperature sender to the water flange.

A. Clean threads of water flange and temperature sender thoroughly. Apply thread sealant to the threads of the sender.

B. Screw sender into the water flange until it is finger tight. Then, tighten sender an additional 2 to 3 full turns.

C. Connect wire harness connector to sender.

8. Fill engine cooling system.

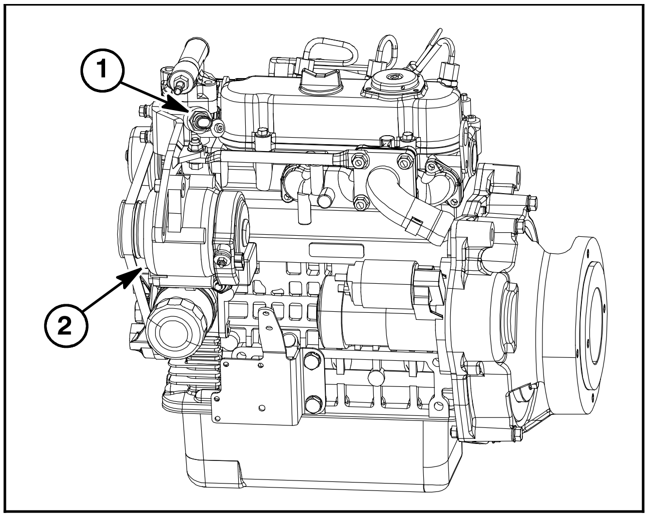


Figure 91

1. **Temperature sender** 2. **Alternator**

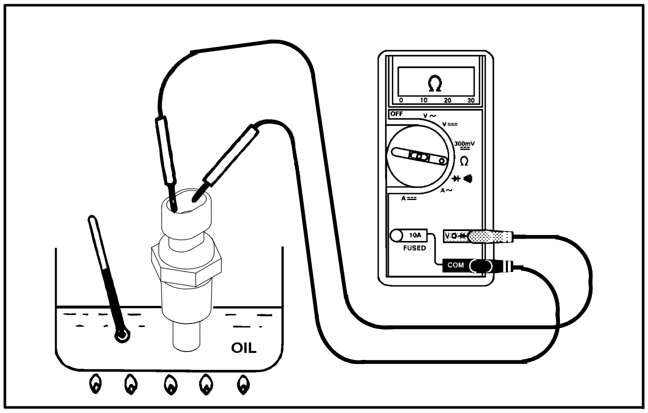


Figure 92

Diode Assembly (Greensmaster 3420)

The Greensmaster 3420 wire harness contains a diode that is used for circuit protection from voltage spikes when the engine starter solenoid is de- energized. The diode plugs into the wire harness in the engine area (see Greensmaster 3420 Wire Harness Drawing in Chapter 10 - Foldout Drawings).

Diode Test

The diode (Fig. 93) can be individually tested using a digital multimeter (diode test or ohms setting) and the table to the right.

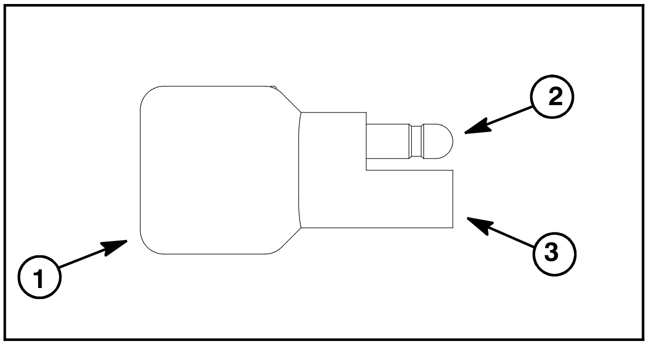


Figure 93

1. **Diode**
2. **Male terminal**
3. **Female terminal**

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (-) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

Turf Guardian^{TM} Leak Detector Oil Level Sensor (If Equipped)

NOTE: The Turf Guardian^{TM} Leak Detector System is optional on Greensmaster TriFlex Hybrid machines.

The leak detector oil level sensor closely monitors the hydraulic fluid level in the main hydraulic reservoir. The sensor is open when the sensor float is in the raised position and closed when the float is in the lowered position. See Turf Guardian^{TM} Leak Detector System Operation in this chapter for information regarding Leak Detector System operation.

Oil Level Sensor Testing

NOTE: On Greensmaster 3320 machines, the leak detector oil level sensor is an input for the TEC controller. Before disconnecting the oil level sensor for testing on a Greensmaster 3320, the sensor and its circuit wiring should be tested as a TEC electrical input using Hand Held Diagnostic Display (see Hand Held Diagnostic Display in the Troubleshooting section of this chapter) or InfoCenter Display (see InfoCenter Display in this chapter). If input testing verifies that the oil level sensor and circuit wiring **are** functioning correctly, no further sensor testing is necessary. If, however, input testing determines that the oil level sensor and circuit wiring **are not** functioning correctly, proceed with the following sensor testing procedure.

1. If the oil level sensor is connected to the main wire harness, remove hydraulic tank cap from filler neck of hydraulic reservoir. Start the engine. Insert a clean rod or screw driver into filler neck and gently push down on sensor float (Fig. 95). Alarm should sound and console leak detector indicator light should illuminate after a one (1) second time delay.

2. If the oil level sensor is removed or disconnected from the main wire harness, connect a continuity tester across the sensor wire terminals. There should be continuity (low resistance) across the sensor connector terminals when the float is pushed down. There should not be continuity (infinite resistance) across the sensor connector terminals when the float is in the raised position.

3. If oil level sensor was removed from reservoir, install oil level sensor into reservoir making sure that arrow on sensor is pointing down (Fig. 96). Torque sensor nut from **110 to 140 in-lb (12.5 to 15.8 N-m)**.

4. After testing, make sure that hydraulic oil level in reservoir is correct.

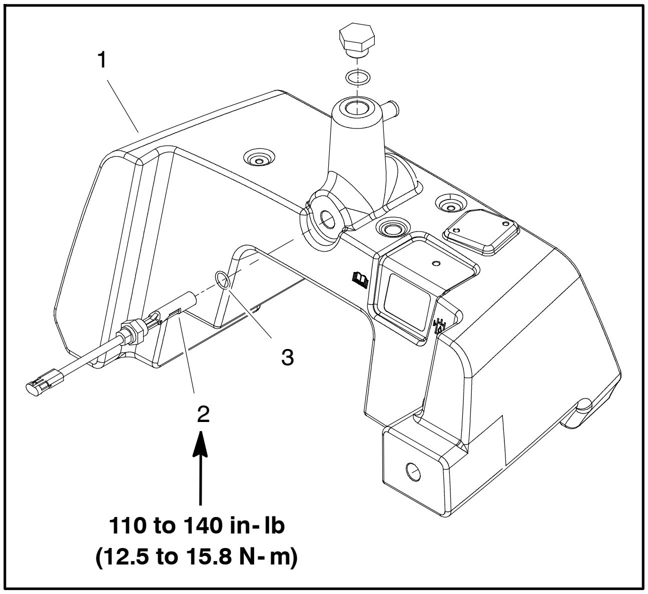


Figure 94

1. **Hydraulic reservoir**
2. **Oil level sensor**
3. **O-ring**

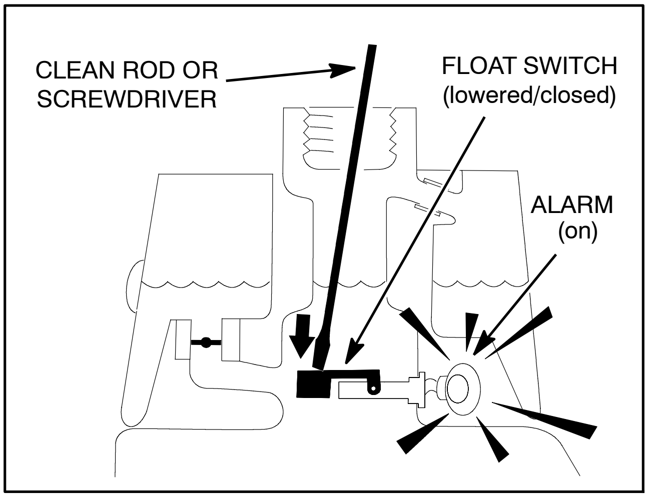


Figure 95

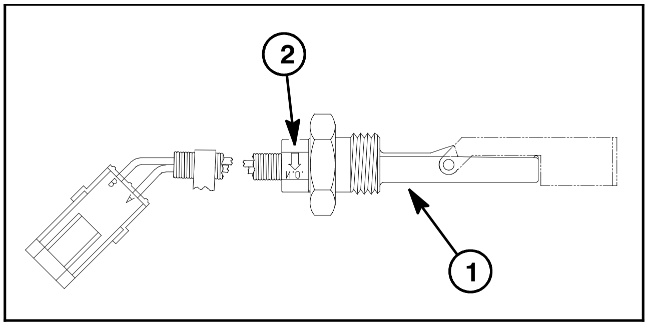


Figure 96

1. **Oil level sensor**
2. **Sensor arrow**

Turf Guardian^{TM} Leak Detector Alarm (If Equipped)

NOTE: The Turf Guardian^{TM} Leak Detector System is optional on Greensmaster TriFlex Hybrid machines.

Machines equipped with the Turf Guardian^{TM} Leak Detector System include an alarm that sounds if a hydraulic leak is detected by the system. The alarm is attached to the outside of the control console assembly.

Testing

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Remove console cover from console assembly to gain access to alarm (see Control Console Disassembly in the Service and Repairs section of Chapter 7 - Chassis).

IMPORTANT: Make sure to observe polarity on the alarm terminals when testing. Damage to the alarm may result from an improper connection.

3. Disconnect wire harness connector from alarm. Correctly connect 12VDC source to the alarm terminals (Fig. 97). Alarm should sound.

4. Remove voltage source from the alarm. Replace alarm if necessary. Connect wire harness connector to alarm.

5. Install console cover (see Control Console Assembly in the Service and Repairs section of Chapter 7 - Chassis).

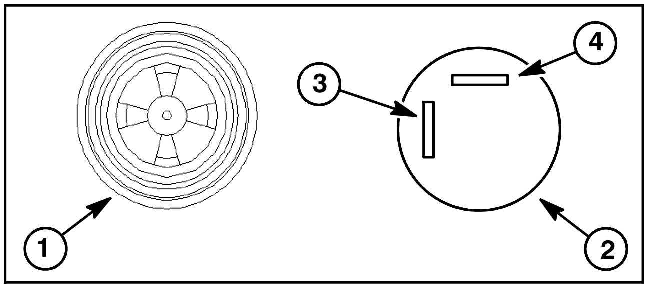


Figure 97

1. **Top view**
2. **Bottom view**
3. **Positive (+) terminal**
4. **Negative (-) terminal**

Verify Interlock System Operation

CAUTION

The interlock switches are for the operator's protection; do not disconnect them. Check the operation of the switches daily to assure the interlock system is operating. If a switch is defective, replace it before operating the machine.

The purposes of the interlock system are to:

A. Prevent the engine from cranking or starting unless the functional control lever is in NEUTRAL.

B. Prevent operating the traction pedal with the functional control lever in NEUTRAL.

C. Prevent operating the traction pedal with the parking brake engaged.

D. Shut off the engine if the operator leaves the seat without the functional control lever in NEUTRAL.

E. Shut off the cutting reels if the functional control lever is moved to NEUTRAL or TRANSPORT.

Interlock Switch Verification

1. Sit on the seat, engage parking brake and move functional control lever to NEUTRAL. Try to depress traction pedal. If the pedal does not depress, the interlock system is operating correctly. Correct problem if not operating properly.

2. With the engine not running, sit on the seat, engage parking brake, keep traction pedal in neutral and place functional control lever in MOW or TRANSPORT. Try to start the engine. If the engine does not crank, the interlock system is operating correctly. Correct problem if not operating properly.

3. Sit on the seat and engage the parking brake. Start the engine and move the functional control lever to MOW. If the engine stops, the interlock system is operating correctly. Correct problem if not operating properly.

4. Sit on the seat and start engine. Move functional control lever to MOW. Raise off the seat. If the engine stops, the interlock system is operating correctly. Correct problem if not operating properly.

5. Sit on the seat and start engine. Move functional control lever to TRANSPORT. Raise off the seat. If the engine stops, the interlock system is operating correctly. Correct problem if not operating properly.

6. Sit on the seat, engage parking brake, keep traction pedal in neutral and place functional control lever in NEUTRAL. Start the engine. Move joystick forward to lower the cutting units. If the units do not start rotating, the interlock system is operating correctly. Correct problem if not operating properly.

12 Volt Battery Care

1. Battery electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where temperatures are cool.

WARNING

Wear safety goggles and rubber gloves when working with battery electrolyte. Charge battery in a well ventilated place so gasses produced while charging can dissipate. Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke. Nausea may result if the gases are inhaled. Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

2. Keep top of battery clean by washing periodically with a brush dipped in baking soda (sodium bicarbonate) solution. Flush top surface with water after cleaning. Do not remove the fill caps while cleaning.

3. Battery cables must be tight on battery terminals to provide good electrical contact.

WARNING

Connecting battery cables to the wrong battery post could result in personal injury and/or damage to the electrical system.

4. If corrosion occurs at battery terminals, disconnect battery cables. Always disconnect negative (–) cable first. Clean cable clamps and terminals separately. Reconnect battery cables with positive (+) cable first. Coat terminals with battery terminal protector (see Special Tools in this chapter) or a light coat of grease to reduce corrosion after connections are made.

5. Check battery electrolyte level every twenty five (25) operating hours and every thirty (30) days if machine is in storage.

6. Maintain battery cell level with distilled or demineralized water. Do not fill cells above the fill line.

12 Volt Battery Storage

If the machine will be stored for more than thirty (30) days:

1. Make sure ignition switch is in the OFF position. Remove the battery and charge it fully (see Battery Service in this section).

2. Either store battery on a shelf or on the machine.

3. Leave cables disconnected if the battery is stored on the machine.

4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the battery from freezing during storage, make sure it is fully charged (see Battery Service in this section).

12 Volt Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

CAUTION

When working with batteries, use extreme caution to avoid splashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

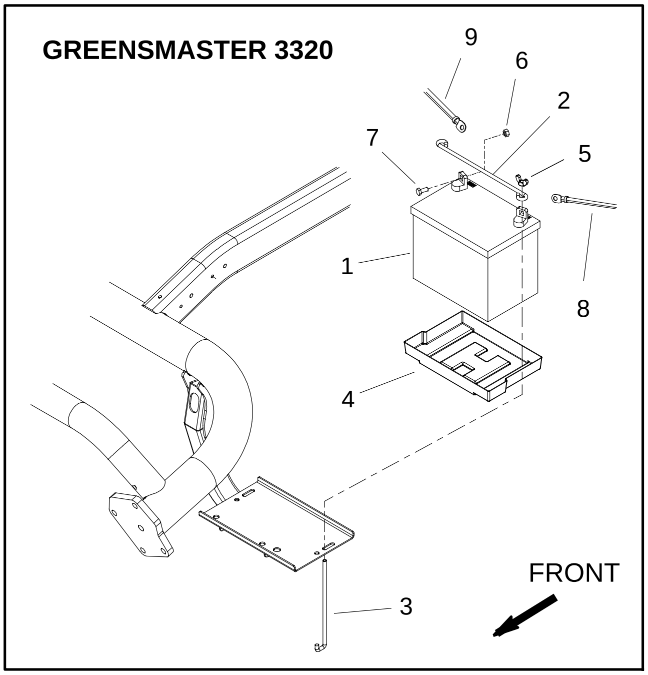


Figure 95

1. **Battery**
2. **Hold down rod**
3. **Post (2 used)**
4. **Battery tray**
5. **Wing nut (2 used)**
6. **Hex nut (2 used)**
7. **Cap screw (2 used)**
8. **Positive battery cable**
9. **Negative battery cable**

Greensmaster 3320 Battery Specifications

BCI Group U1 Battery
300 Amp Cranking Performance at 0°F (–18°C)
28 minute Reserve Capacity at 80°F (27°C)
Electrolyte Specific Gravity (fully charged): from 1.250 to 1.280
Electrolyte Specific Gravity (discharged): 1.240

Greensmaster 3420 Battery Specifications

BCI Group 55 Battery
585 Amp Cranking Performance at 0°F (–18°C)
95 minute Reserve Capacity at 80°F (27°C)
Electrolyte Specific Gravity (fully charged): from 1.250 to 1.280
Electrolyte Specific Gravity (discharged): 1.240

Battery Removal (Fig. 95 or 96)

IMPORTANT: Be careful to not damage terminal posts or cable connectors when removing the battery cables.

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Disconnect the negative cable (–) from the battery first to prevent short circuiting the battery, other components or the operators hands. Then disconnect the positive (+) cable.

3. Remove fasteners and retainer components that secure battery to frame.

4. Make sure that the battery filler caps are on tightly.

5. Remove battery from the battery compartment and move battery to a service area. This will minimize possible battery damage and allow better access for battery inspection and service.

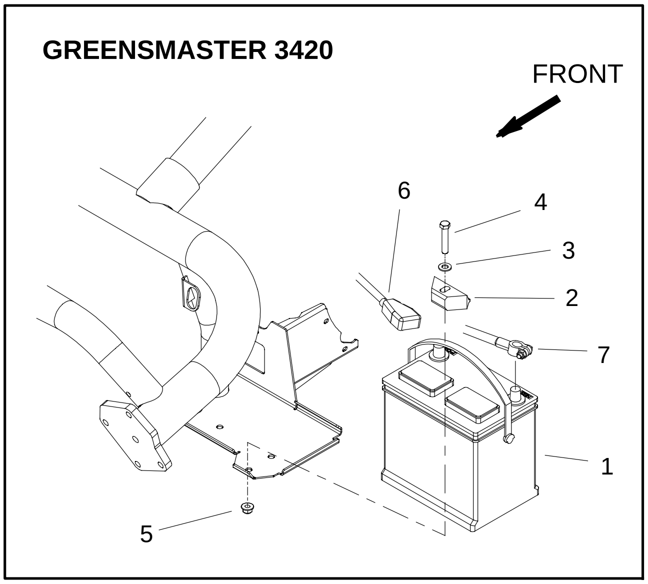


Figure 96

1. **Battery**
2. **Battery retainer**
3. **Flat washer**
4. **Cap screw**
5. **Flange nut**
6. **Positive battery cable**
7. **Negative battery cable**

Battery Inspection and Maintenance

1. Perform following inspections and maintenance:

   A. Check for cracks caused by overly tight or loose hold–down retainer. Replace battery if cracked or leaking.

   B. Check battery terminal posts for corrosion. Use a terminal brush or steel wool to clean corrosion from the battery terminal posts.

   IMPORTANT: Before cleaning the battery, tape or block the vent holes to the filler caps and make sure the caps are on tightly.

   C. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling. Also, check the battery case for dirt and oil. Clean the battery with a solution of baking soda (sodium bicarbonate) and water, then rinse it with clean water.

   D. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

   IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

   E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water to the bottom of the cap tubes. Charge at 15 to 25 amps for fifteen (15) minutes to allow sufficient mixing of the electrolyte.

Battery Installation (Fig. 95 or 96)

IMPORTANT: To prevent possible electrical problems, install only a fully charged battery.

1. Make sure the ignition switch and all accessories are off.

2. Make sure the battery compartment is clean and repainted if necessary.

3. Make sure that battery cables, retainer components and posts are in good condition.

4. Place the battery in its compartment. Make sure battery is level and flat.

5. Secure battery to frame with removed fasteners and retainer components. Do not overtighten fasteners to prevent cracking or distorting the battery case.

6. Connect the positive cable to the positive battery post. Tighten bolt with two (2) wrenches.

NOTE: Before connecting the negative (ground) cable, connect a digital multimeter (set to amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the machine’s electrical system should be tested for short circuits or faulty components and repaired.

7. Connect the negative (ground) cable to the negative battery post. Tighten bolt with two (2) wrenches.

8. Coat battery posts and cable connectors with battery terminal protector (see Special Tools in this chapter) or petroleum jelly to prevent corrosion.

Battery Testing

1. Conduct a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm-up the hydrometer. At the same time take the temperature of the cell.

B. Temperature correct each cell reading:

For each 10°F (6°C) above 80°F (27°C), add 0.004 to the specific gravity reading.

For each 10°F (6°C) below 80°F (27°C), subtract 0.004 from the specific gravity reading.

Example:		
	Cell Temperature	100°F
	Cell Specific Gravity	1.245
	ADD (20° above 80°F)	0.008
	Temperature Correction	1.253

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Battery Charging** or until specific gravity of all all cells is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

2. Perform a high-discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is **required** to perform this test.

CAUTION

Follow the battery load tester manufacturer's instructions when using a load tester.

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.0 VDC, recharge the battery.

B. If the battery has been charged, apply a 150 amp load for fifteen (15) seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

C. Make sure the battery terminals are free of corrosion.

D. Measure the temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of 150 amps (one half the cranking performance rating of the battery) for fifteen (15) seconds.

G. Take a battery voltage reading after fifteen (15) seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the center cell temperature reading.

Minimum Voltage	**Battery Electrolyte Temperature**	
9.6	70°F (and up)	21°C (and up)
9.5	60°F	16°C
9.4	50°F	10°C
9.3	40°F	4°C
9.1	30°F	−1°C
8.9	20°F	−7°C
8.7	10°F	−12°C
8.5	0°F	−18°C

I. If the test voltage is below the minimum voltage listed in the table, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Battery Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is available in most shops.

CAUTION

Follow the battery charger manufacturer's instructions when using a battery charger.

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its specific gravity or open circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the battery charger manufacturer's instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	**50%**	**25%**	**0%**
80 or less **(GR3320)**	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125 **(GR3420)**	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (16°C) before connecting to a charger.

Charge the battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. **Following the battery charger manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the battery charger manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125°F (52°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three (3) hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three (3) consecutive readings.

Electric Reel Drive System (48 Volt DC) Battery Pack Service

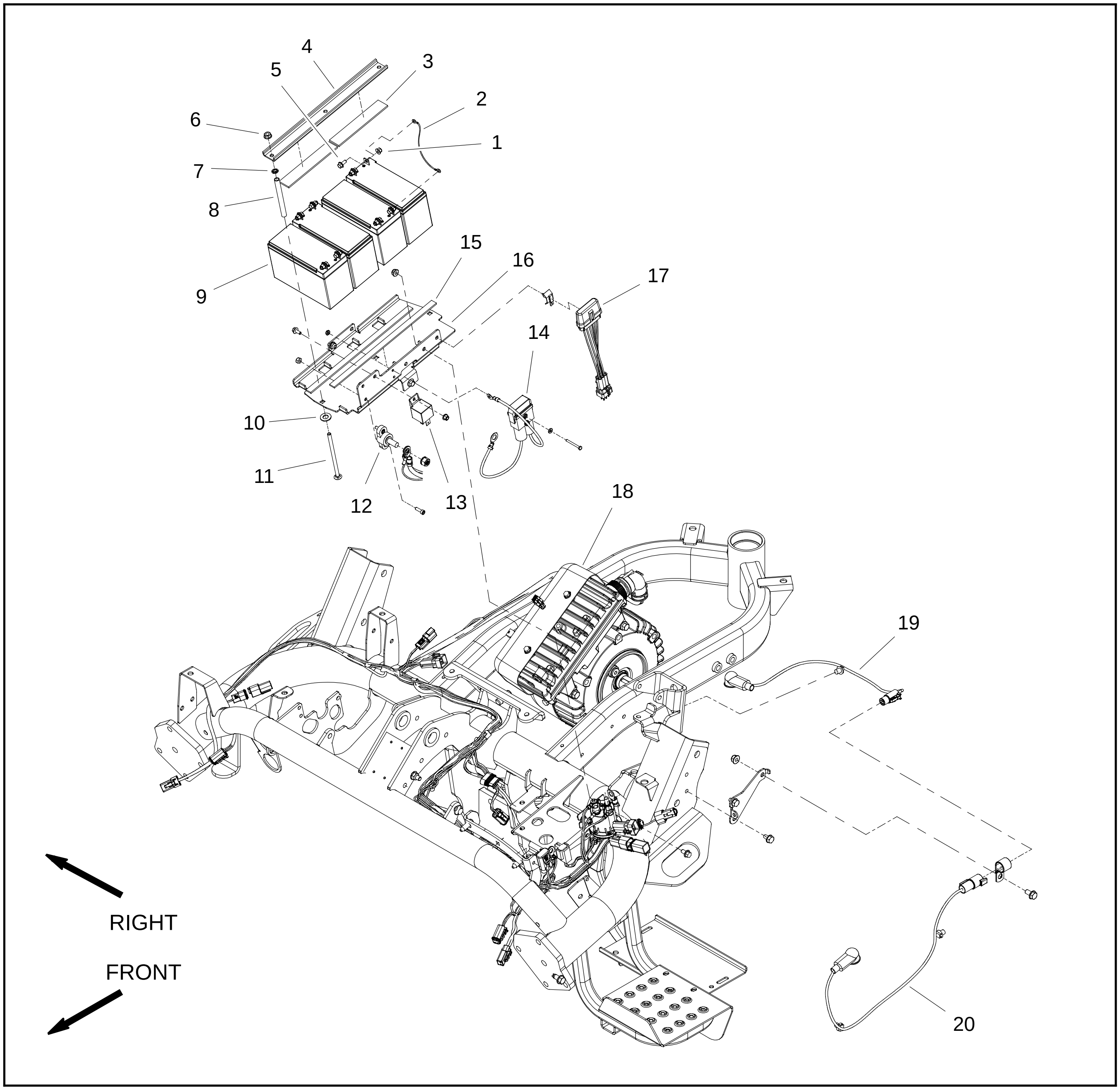


Figure 97

1. **Flange nut (8 used)**
2. **Battery jumper wire (3 used)**
3. **Foam strip (2 used)**
4. **Battery clamp**
5. **Flange head screw (8 used)**
6. **Flange nut (3 used)**
7. **Retaining nut (3 used)**
8. **Tube (3 used)**
9. **Battery (4 used)**
10. **Washer (3 used)**
11. **Carriage screw (3 used)**
12. **Junction block**
13. **Cutting reel enable relay**
14. **Maxi fuse holder**
15. **Foam strip (2 used)**
16. **Battery plate**
17. **Cutting reel ID module**
18. **Generator assembly**
19. **Battery disconnect harness**
20. **Battery disconnect harness**

The batteries used in the TriFlex electric reel drive system are valve regulated, sealed lead acid batteries. The batteries are maintenance free with no provision for checking or adjusting electrolyte level. The batteries are equipped with a low pressure venting system designed to release excess gas pressure and then automatically reseal. A low self discharge rate prevents deterioration of battery performance during non–use or storage.

Battery Pack Removal (Fig. 97)

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers to prevent unexpected cutting unit operation (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter).

3. Remove left side cover next to operator seat to allow access to battery pack.

4. Using two (2) wrenches, remove flange nuts and flange head screws that secure cables to battery terminals. Remove three (3) jumper wires and position remaining two (2) cables away from battery terminals.

5. Remove battery clamp (item 4) to allow battery removal.

6. Remove batteries from machine.

7. Inspect foam strips on battery plate and battery clamp. Replace strips if damaged.

Battery Pack Installation (Fig. 97)

1. Make sure that the cutting unit power disconnect couplers are separated to prevent unexpected cutting unit operation (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter).

2. Place batteries onto battery plate in machine noting positions of battery terminals (Fig. 99).

3. Secure batteries with battery clamp (item 4).

IMPORTANT: When connecting the battery pack in the 48 volt system, make sure that battery polarity is carefully checked. Damage to fuses or other system components can occur if batteries are not connected correctly.

4. Position and secure three (3) jumper wires and two (2) battery cables to battery terminals. Use two (2) wrenches to tighten fasteners.

5. Install left side cover next to operator seat.

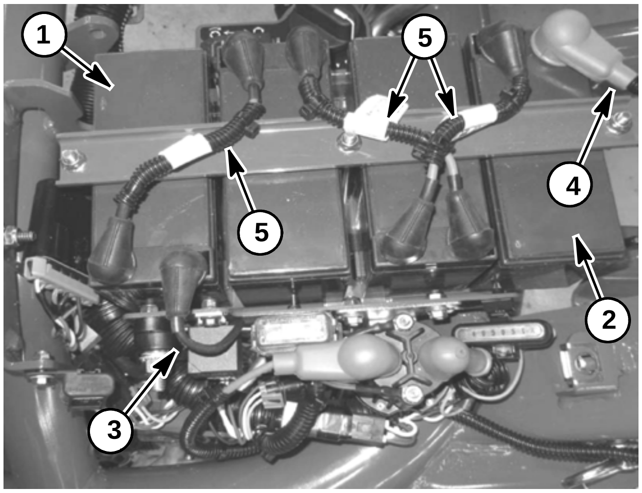


Figure 98

1. **Front battery**
2. **Rear battery**
3. **Cable from fuse holder**
4. **Disconnect harness**
5. **Jumper wire**

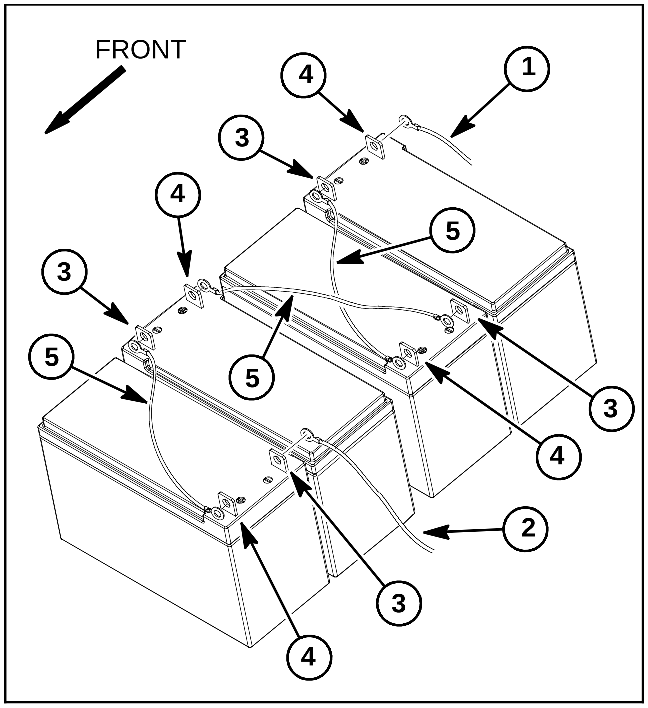


Figure 99

1. **Cable to disconnect**
2. **Cable to fuse holder**
3. **Negative (–) terminal**
4. **Positive (+) terminal**
5. **Jumper wire**

Battery Pack Service

Clean the battery pack with clean water and a towel. Do not use solvents or chemicals to clean the battery pack.

When testing batteries in your Greensmaster, it is important to test all four (4) individual batteries. Proper performance of the machine depends on all batteries being in good condition. Testing will determine if one (or more) of the batteries needs to be replaced.

A simple battery test can be done using a multimeter to perform a voltage test of each of the batteries in the battery pack. Measure the battery voltage with the multimeter and record battery voltage. The measured voltage can be used to determine battery state of charge. If the voltage of any of the batteries varies by more than 10%, it indicates a problem with the lower voltage battery.

If the battery pack system voltage drops below 50VDC due to storage, age or malfunction, battery inspection and/or charging may be necessary. The batteries may be individually charged with a 12V charger rated for operation with absorbed glass mat (AGM), valve regulated lead acid batteries. The voltage of this battery type is slightly lower than flooded lead acid batteries. Maximum charge current should be limited to 2.4 amps.

A battery load tester can be used to test individual batteries. Many locally available battery load testers do not, however, have any adjustment on the load that is put on the battery. Results received from using load testers should follow the recommendations of the load tester manufacturer.

Battery Pack Storage

There are no special procedures or precautions for battery storage less than six (6) months. However, storage above 70^{o}F (21^{o}C) will significantly reduce battery life. Cold temperatures are not an issue during storage and actually will reduce the battery self–discharge rate. To obtain maximum battery life, do not store the battery pack in a discharged state.

If storage is anticipated for longer than six (6) months, inspection and/or charging is recommended at six (6) month intervals. Battery charging is recommended whenever the battery pack voltage drops below 50VDC or if voltage of an individual battery drops below 12.5VDC.

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Generator Drive Belt (Greensmaster 3320)

Removal (Fig. 100)

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

CAUTION

Be careful when removing idler bracket torsion spring tension. The torsion spring applies a heavy load that may cause personal injury.

3. Remove torsion spring tension from generator belt idler bracket (Fig. 101):

   A. Use a 3/4" wrench on spring adjust arm pivot to prevent adjust arm from rotating.

   B. Remove flange nut and cap screw that secure spring adjust assembly to engine frame.

   C. Using 3/4" wrench to control spring adjust arm pivot, allow torsion spring tension to relax.

4. While holding idler pulley away from generator belt, remove belt from idler pulley.

5. Move pump assembly away from pump mount to allow removal of generator belt (Fig. 102):

CAUTION

Support the pump assembly when removing its supporting fasteners to prevent it from falling and causing damage or personal injury.

   A. Support pump assembly to prevent it from falling.

   B. Remove two (2) cap screws and flat washers that secure pump assembly to pump mount.

   C. Carefully slide pump assembly away from the pump mount attached to engine so that generator belt can be removed. Take care to not damage hydraulic hoses, traction control cable or other components as pump assembly is moved.

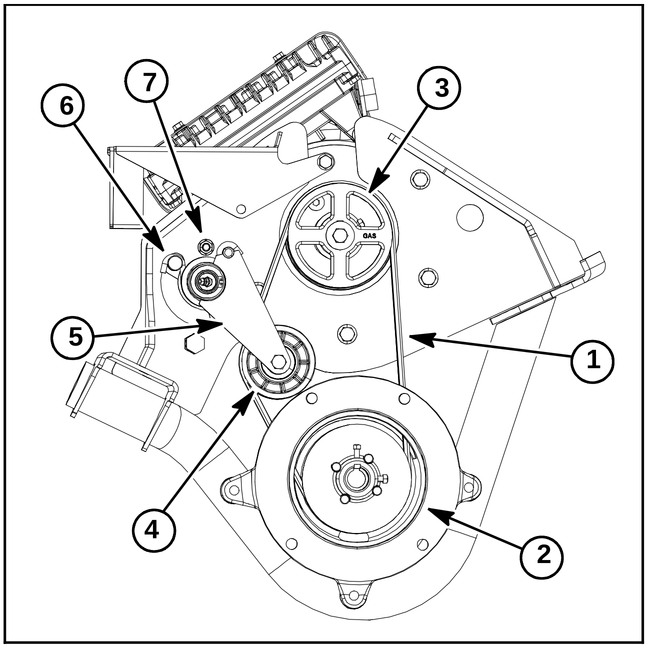

Figure 100

1. **Generator belt**
2. **Engine pulley**
3. **Generator pulley**
4. **Idler pulley**
5. **Idler bracket**
6. **Spring adjust assembly**
7. **Cap screw/nut**

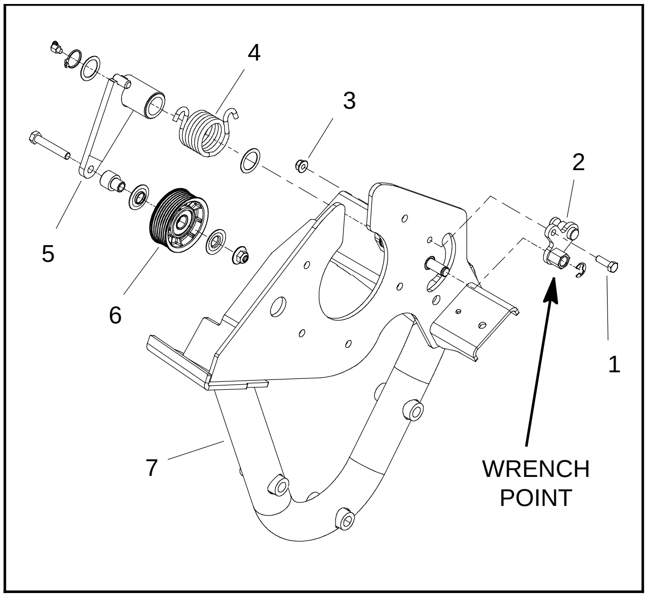

Figure 101

1. **Cap screw**
2. **Spring adjust assembly**
3. **Flange nut**
4. **Torsion spring**
5. **Idler bracket**
6. **Idler pulley**
7. **Engine frame**

6. Remove generator belt from pulleys and machine.

7. Inspect generator belt and replace belt if worn or damaged.

Installation (Fig. 100)

1. Position generator belt to engine, generator and idler pulleys.

2. Secure pump assembly to pump mount (Fig. 102):

   A. Carefully insert coupling on pump shaft into coupling attached to engine and slide pump assembly to pump mount. Take care to not damage hydraulic hoses, traction control cable or other components as pump assembly is installed.

   B. Secure pump assembly to pump mount with two (2) cap screws and flat washers.

CAUTION

Be careful when applying idler bracket torsion spring tension. The torsion spring applies a heavy load that may cause personal injury.

3. Apply torsion spring tension to generator belt idler bracket (Fig. 101):

   A. Use a 3/4” wrench to rotate adjust arm assembly until hole in arm aligns with hole in engine frame.

   B. Insert cap screw through hole in spring adjust assembly and engine frame. Install flange nut to secure torsion spring.

4. Connect the cutting unit power disconnect couplers.

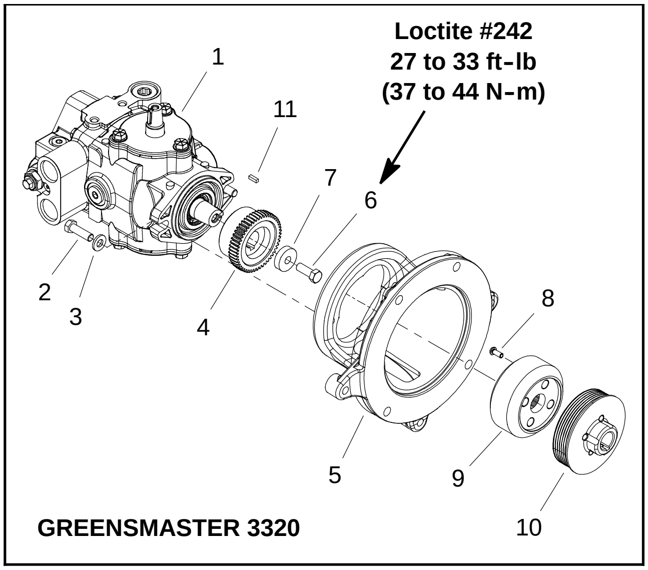

Figure 102

1. **Piston pump**
2. **Cap screw (2 used)**
3. **Flat washer (2 used)**
4. **Coupling**
5. **Pump mount**
6. **Cap screw**
7. **Spacer**
8. **Screw (4 used)**
9. **Coupling**
10. **Generator drive pulley**
11. **Key**

Generator Drive Belt (Greensmaster 3420)

Removal (Fig. 103)

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

CAUTION

Be careful when rotating the idler bracket. The torsion spring that tensions the bracket applies a heavy load that may cause personal injury.

3. Use a 3/8” drive breaker bar in idler bracket square drive hole to rotate and hold idler pulley away from generator belt.

4. While holding idler pulley away from generator belt, remove belt from idler pulley. Then, use breaker bar to allow idler bracket to rotate and relax torsion spring tension.

5. Move pump assembly away from bell housing to allow removal of generator belt (Fig. 104):

CAUTION

Support the pump assembly when removing its supporting fasteners to prevent it from falling and causing damage or personal injury.

A. Support pump assembly to prevent it from falling.

B. Remove two (2) cap screws and flat washers that secure pump assembly to bell housing.

C. Carefully slide pump assembly away from the bell housing attached to engine so that generator belt can be removed. Take care to not damage hydraulic hoses, traction control cable or other components as pump assembly is moved.

6. Remove generator belt from pulleys and machine.

7. Inspect generator belt and replace belt if worn or damaged.

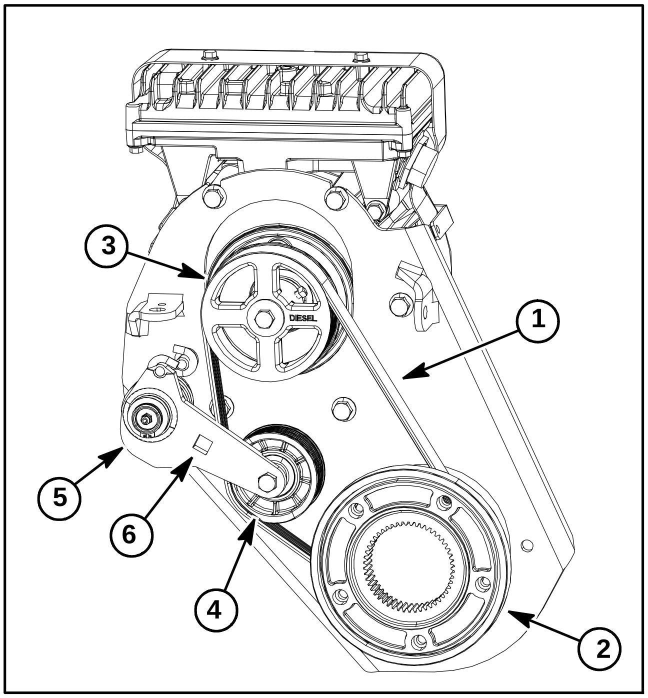

Figure 103

1. **Generator belt**
2. **Engine pulley**
3. **Generator pulley**
4. **Idler pulley**
5. **Idler bracket**
6. **3/8” square drive hole**

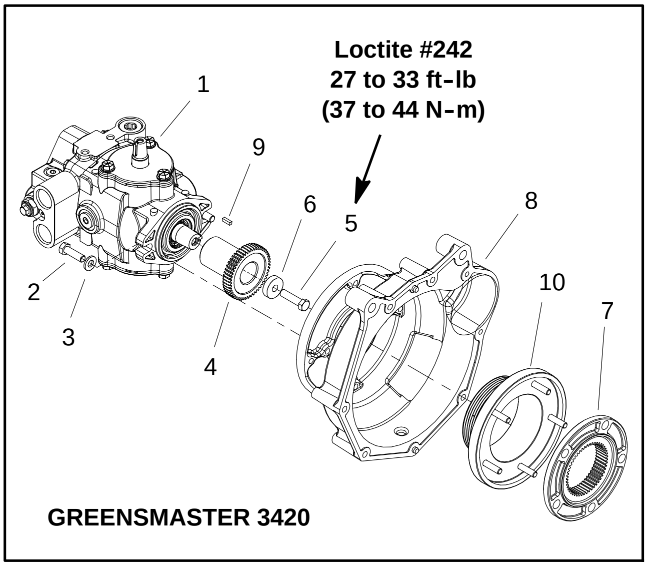

Figure 104

1. **Piston pump**
2. **Cap screw (2 used)**
3. **Flat washer (2 used)**
4. **Coupling**
5. **Cap screw**
6. **Spacer**
7. **Engine coupling flange**
8. **Bell housing**
9. **Key**
10. **Generator drive pulley**

Installation (Fig. 103)

1. Position generator belt to engine and generator pulleys.

2. Secure pump assembly to bell housing (Fig. 104):

    A. Carefully insert coupling on pump shaft into coupling attached to engine and slide pump assembly to bell housing. Take care to not damage hydraulic hoses, traction control cable or other components as pump assembly is installed.

    B. Secure pump assembly to bell housing with two (2) cap screws and flat washers.

CAUTION

Be careful when rotating the idler bracket. The torsion spring that tensions the bracket applies a heavy load that may cause personal injury.

3. Use a 3/8” drive breaker bar in idler bracket square drive hole to rotate and hold idler pulley away from generator belt.

4. While holding idler pulley away from generator belt, install belt onto idler pulley. Then, use breaker bar to allow idler bracket to rotate and tension generator belt.

5. Connect the cutting unit power disconnect couplers.

Generator Assembly (Greensmaster 3320)

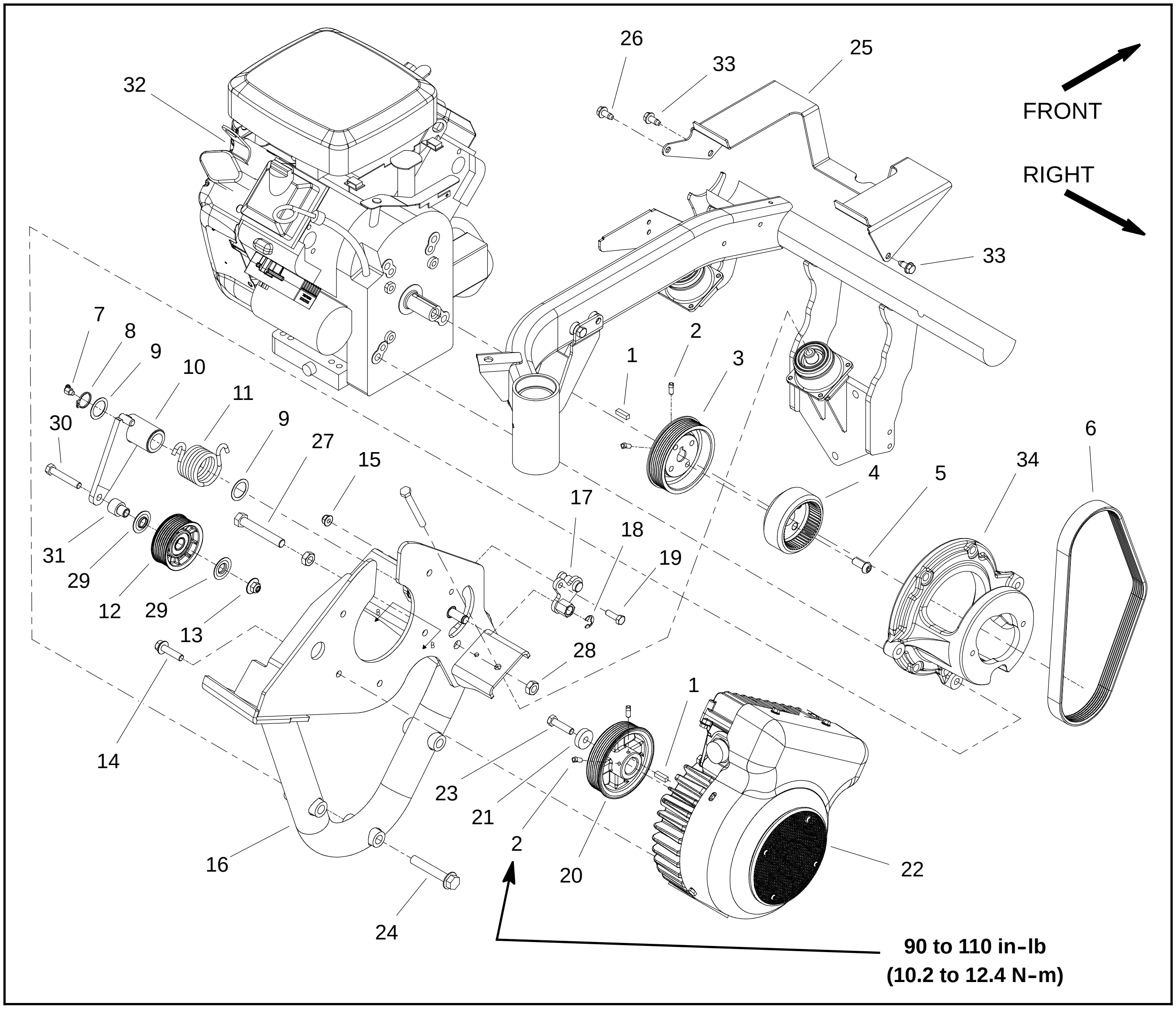

Figure 105

1. **Square key (2 used)**
2. **Square head screw (4 used)**
3. **Engine pulley**
4. **Pump coupling**
5. **Screw (4 used)**
6. **Generator belt**
7. **Grease fitting**
8. **Retaining ring**
9. **Washer (2 used)**
10. **Idler bracket**
11. **Torsion spring**
12. **Idler pulley**
13. **Flange nut**
14. **Flange head screw (5 used)**
15. **Flange nut**
16. **Engine frame**
17. **Spring adjust bracket**
18. **Retaining ring**
19. **Cap screw**
20. **Generator pulley**
21. **Spacer**
22. **Generator assembly**
23. **Cap screw**
24. **Flange head screw (3 used)**
25. **Belt shield**
26. **Washer head screw**
27. **Cap screw**
28. **Jam nut (2 used)**
29. **Dirt exclusion washer (2 used)**
30. **Cap screw**
31. **Idler pulley spacer**
32. **Engine assembly**
33. **Washer head screw (2 used)**
34. **Pump mount**

NOTE: If electrical problems exist with the generator assembly, a fault should have occurred that would be indicated by a flashing diagnostic light on the console (serial number below 312000000) or fault indicator on the InfoCenter (serial number above 312000000). Before considering that generator service work is necessary, check for any existing fault codes that indicate problems with the generator.

Removal (Fig. 105)

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. To allow access to generator assembly, remove tank mount plate assembly from machine (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 – Chassis).

4. Remove generator drive belt (see Generator Drive Belt (Greensmaster 3320) in this section).

5. Disconnect wire harness connector from generator assembly.

CAUTION

Support generator assembly when removing it to prevent it from falling and causing personal injury. Assembly weighs approximately 50 pounds (23 kg).

6. Support generator to prevent it from falling or shifting.

7. Remove five (5) flange head screws (item 14) that secure generator assembly to engine frame.

IMPORTANT: Make sure to not damage the generator, fuel lines, hydraulic hoses, electrical harness, control cables or other parts while removing the generator assembly.

8. Carefully remove generator assembly from machine.

9. If necessary, remove generator pulley from generator shaft:

   A. Remove cap screw (item 23) and spacer (item 21) that secure generator pulley to generator shaft.

   B. Loosen the two (2) square head screws (item 2) that secure the generator pulley to the generator shaft.

   C. Slide generator pulley from generator shaft. Locate and retrieve square key (item 1).

Installation (Fig. 105)

1. If removed, install generator pulley to generator shaft:

   A. Apply antiseize lubricant to generator shaft. Position square key (item 1) into slot in shaft.

   B. Slide generator pulley onto generator shaft. Make sure that pulley flange is positioned towards the generator.

   C. Install and tighten spacer (item 21) and cap screw (item 23) to secure generator pulley to generator shaft.

   D. Install two (2) square head screws (item 2) in generator pulley flange. Torque screws from **90 to 110 in–lb (10.2 to 12.4 N–m)**.

CAUTION

Support generator assembly when installing it to prevent it from falling and causing personal injury. Assembly weighs approximately 50 pounds (23 kg).

IMPORTANT: Make sure to not damage the generator, fuel lines, hydraulic hoses, electrical harness, control cables or other parts while installing the generator assembly.

2. Carefully position generator assembly to engine frame.

3. Secure generator assembly to engine frame with five (5) flange head screws (item 14).

4. Connect wire harness connector to generator assembly.

5. Install generator drive belt (see Generator Drive Belt (Greensmaster 3320) in this section). Make sure that drive belt is properly tensioned.

6. Install tank mount plate assembly to machine (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 – Chassis).

7. Check hydraulic oil level in reservoir and adjust if necessary.

8. Connect the cutting unit power disconnect couplers.

Generator Assembly (Greensmaster 3420)

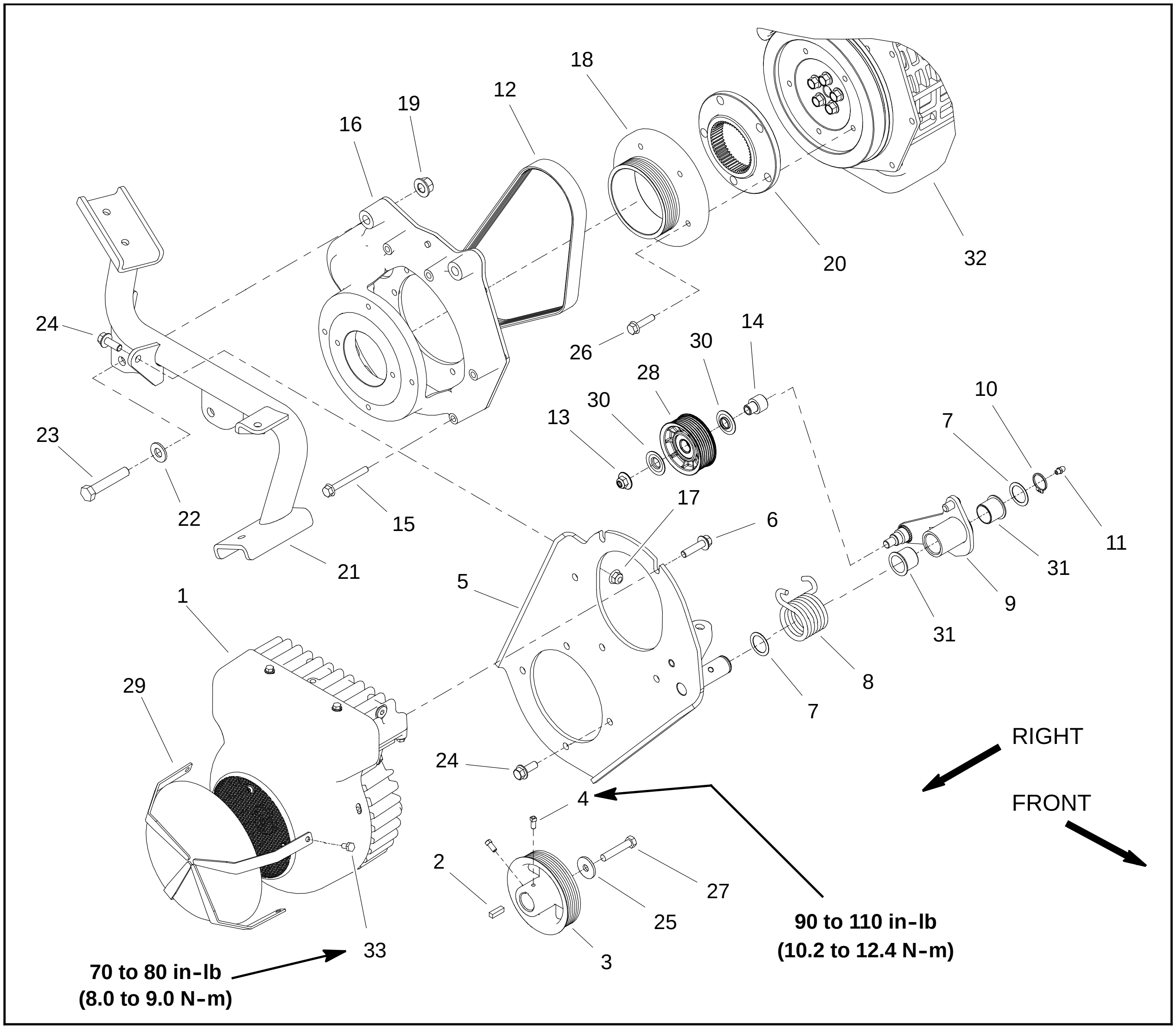

Figure 106

1. **Generator assembly**
2. **Square key**
3. **Generator pulley**
4. **Square head screw (2 used)**
5. **Generator plate**
6. **Flange head screw (5 used)**
7. **Washer (2 used)**
8. **Torsion spring**
9. **Idler bracket**
10. **Retaining ring**
11. **Grease fitting**
12. **Generator belt**
13. **Flange nut**
14. **Idler pulley spacer**
15. **Flange head screw (5 used)**
16. **Bell housing**
17. **Flange nut (5 used)**
18. **Engine pulley**
19. **Lock nut (2 used)**
20. **Coupling flange**
21. **Rear engine mount**
22. **Thrust washer (2 used)**
23. **Cap screw (2 used)**
24. **Flange head screw (6 used)**
25. **Washer**
26. **Flange head screw (5 used)**
27. **Cap screw**
28. **Idler pulley**
29. **Generator guard**
30. **Dirt exclusion washer (2 used)**
31. **Flange bushing (2 used)**
32. **Engine assembly**
33. **Washer head screw (4 used)**

NOTE: If electrical problems exist with the generator assembly, a fault should have occurred that would be indicated by a flashing diagnostic light on the console (serial number below 312000000) or fault indicator on the InfoCenter (serial number above 312000000). Before considering that generator service work is necessary, check for any existing fault codes that indicate problems with the generator.

Removal (Fig. 106)

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. To allow access to generator assembly, remove tank mount plate assembly from machine (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 – Chassis).

4. Remove generator drive belt (see Generator Drive Belt (Greensmaster 3420) in this section).

5. Disconnect wire harness connector from generator assembly.

CAUTION

Support generator assembly when removing it to prevent it from falling and causing personal injury. Assembly weighs approximately 50 pounds (23 kg).

6. Support generator to prevent it from falling or shifting.

NOTE: Upper two (2) generator mounting locations on generator plate (item 5) are slotted.

7. Loosen upper two (2) flange head screws (item 6) that secure generator assembly to generator plate. Then, remove remaining three (3) screws (item 6) that secure generator.

IMPORTANT: Make sure to not damage the generator, fuel lines, hydraulic hoses, electrical harness, control cables or other parts while removing the generator assembly.

8. Carefully raise generator assembly to disengage upper two (2) screws from generator plate. Then, remove generator from machine.

9. If necessary, remove generator pulley from generator shaft:

   A. Remove cap screw (item 27) and spacer (item 25) that secure generator pulley to generator shaft.

   B. Loosen the two (2) square head screws (item 4) that secure the generator pulley to the generator shaft.

   C. Slide generator pulley from generator shaft. Locate and retrieve square key (item 2).

10. If generator disassembly is necessary, remove generator guard (item 29) from generator.

Installation (Fig. 106)

1. If removed, install generator pulley to generator shaft:

   A. Apply antiseize lubricant to generator shaft. Position square key (item 2) into slot in shaft.

   B. Slide generator pulley onto generator shaft. Make sure that pulley flange is positioned towards the generator.

   C. Install and tighten spacer (item 25) and cap screw (item 27) to secure generator pulley to generator shaft.

   D. Install two (2) square head screws (item 4) in generator pulley flange. Torque screws from **90 to 110 in–lb (10.2 to 12.4 N–m)**.

2. Install generator guard (item 29) if it was removed from generator.

CAUTION

Support generator assembly when installing it to prevent it from falling and causing personal injury. Assembly weighs approximately 50 pounds (23 kg).

IMPORTANT: Make sure to not damage the generator, fuel lines, hydraulic hoses, electrical harness, control cables or other parts while installing the generator assembly.

3. Loosely install upper two (2) flange head screws (item 6) into generator assembly. Carefully position generator assembly to generator plate and engage upper screws in generator plate slots.

4. Secure generator assembly to generator plate with five (5) flange head screws (item 6).

5. Connect wire harness connector to generator assembly.

6. Install generator drive belt (see Generator Drive Belt (Greensmaster 3420) in this section). Make sure that drive belt is properly tensioned.

7. Install tank mount plate assembly to machine (see Tank Mount Plate Assembly in the Service and Repairs section of Chapter 7 – Chassis).

8. Check hydraulic oil level in reservoir and adjust if necessary.

9. Connect the cutting unit power disconnect couplers.

Generator Assembly Service

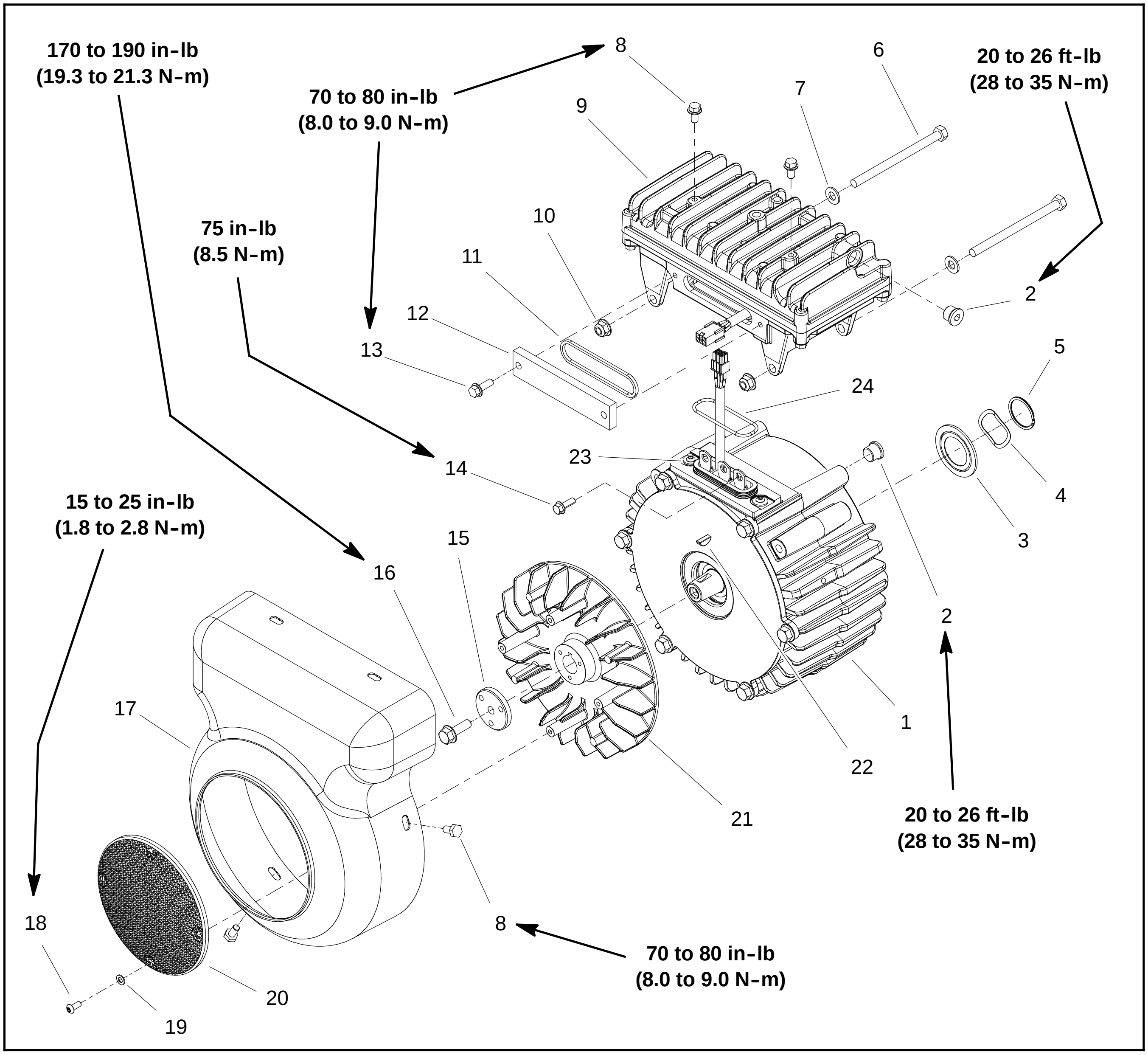
170 to 190 in-lb
(19.3 to 21.3 N-m)
8
70 to 80 in-lb
(8.0 to 9.0 N-m)
9
6
7
20 to 26 ft-lb
(28 to 35 N-m)
75 in-lb
(8.5 N-m)
10
11
12
13
2
5
24
23
14
4
3
15 to 25 in-lb
(1.8 to 2.8 N-m)
15
16
2
17
1
22
21
20 to 26 ft-lb
(28 to 35 N-m)
18
8
70 to 80 in-lb
(8.0 to 9.0 N-m)
20
19

Figure 107

1. **Generator assembly**
2. **Plug (2 used)**
3. **Flocked seal**
4. **Wave washer**
5. **Retaining ring**
6. **Cap screw (2 used)**
7. **Flat washer (2 used)**
8. **Washer head screw (6 used)**
9. **Controller assembly**
10. **Flange nut (2 used)**
11. **Cover gasket**
12. **Access cover**
13. **Washer head screw (2 used)**
14. **Flange head screw (3 used)**
15. **Collar**
16. **Flange head screw**
17. **Generator cover**
18. **Torx screw (4 used)**
19. **Flat washer (4 used)**
20. **Fan screen**
21. **Generator fan**
22. **Woodruff key**
23. **Button head screw (2 used)**
24. **O-ring**

Disassembly (Fig. 107)

1. Remove fan screen (item 20) from generator fan.

2. Remove generator cover (item 17) from generator assembly.

3. Remove access cover (item 12) and cover gasket (item 11) from controller. Discard cover gasket.

4. Carefully remove generator and controller harness connectors from controller opening. Note position of connectors and wire harnesses for assembly purposes. Unplug connectors.

5. Remove three (3) flange head screws (item 14) that secure generator stator conductors to controller connectors.

6. Remove cap screws (item 6), flat washers (item 7) and flange nuts (item 10) that secure controller to generator assembly. Lift controller from generator. Remove and discard O–ring (item 24).

NOTE: If controller (item 9) damage exists, controller replacement is necessary. Internal controller components are not available separately.

7. Remove flange head screw (item 16) and collar (item 15) from generator shaft.

8. Remove generator fan. Generator fan can be removed with collar (item 15), three (3) fan screen screws (item 18), a 3/8" – 16 UNC cap screw and a thick washer or spacer as follows:

IMPORTANT: To prevent damage to generator shaft threads, position a thick washer or spacer on the end of the shaft before removing the generator fan.

A. Position thick washer or spacer on the end of the generator shaft.

B. Position collar (item 15) to generator fan and align three (3) holes in collar with tapped holes in fan.

C. Insert three (3) torx screws (item 18) through collar and into threaded holes in fan.

D. Thread 3/8" – 16 UNC cap screw into center hole of collar and against washer on generator shaft.

E. Support fan to prevent it from falling and then tighten screw to remove fan.

F. Locate and retrieve woodruff key (item 22).

9. Remove retaining ring (item 5), wave washer (item 4) and flocked seal (item 3) from generator shaft. Note orientation of flocked seal for assembly purposes.

10. Remove internal generator assembly components (Fig. 108):

A. Remove six (6) flange head screws that secure cover to housing. Leave cover on rotor shaft.

IMPORTANT: The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during removal. Be cautious during rotor removal to prevent component damage or personal injury.

B. Use generator rotor tool set (see Special Tools in this chapter) to carefully remove rotor assembly including cover from housing.

C. Remove cover from rotor assembly. Remove O–rings and wave washer from cover. Discard O–rings.

D. Remove and discard O–ring from housing groove in bearing bore.

E. If necessary, remove bearings from rotor. Discard bearings if removed.

F. If necessary, remove isolator from housing assembly.

11. Inspect rotor assembly for wear or damage. Also, inspect generator housing/stator assembly for evidence of damage.

NOTE: If generator housing/stator damage exists, generator assembly replacement is necessary. The generator housing and stator are not available separately.

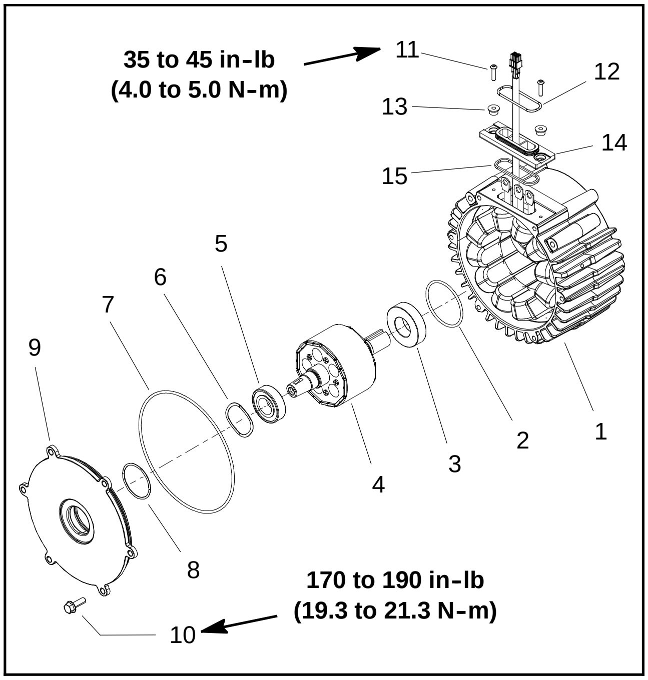

Figure 108

1.	**Housing/stator assembly**	9.	**Cover**
2.	**O–ring**	10.	**Flange screw (6 used)**
3.	**Bearing**	11.	**Screw (2 used)**
4.	**Rotor assembly**	12.	**O–ring**
5.	**Bearing**	13.	**Spacer (2 used)**
6.	**Wave washer**	14.	**Isolator**
7.	**O–ring**	15.	**Gasket**
8.	**O–ring**		

Assembly (Fig. 107)

1. Make sure that all generator components are cleaned before assembly.

2. Install internal generator assembly components (Fig. 108):

   A. If bearings were removed from rotor assembly, install new bearings onto rotor shaft. Make sure that new bearings are fully pressed onto rotor shaft.

   B. If isolator was removed, lubricate new gasket with dielectric lubricant (see Special Tools in this chapter) and install to isolator. Fit isolator to housing assembly making sure that stator conductors and stator harness are correctly positioned in isolator. Secure isolator with spacers and screws. Torque screws from **35 to 45 in-lb (4.0 to 5.0 N-m)**.

   C. Lubricate new O-ring with dielectric lubricant (see Special Tools in this chapter) and install into groove in housing bearing bore.

   IMPORTANT: The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during installation. Be cautious during rotor installation to prevent component damage or personal injury.

   D. Use generator rotor tool set (see Special Tools in this chapter) to carefully install rotor assembly into housing. Makes sure that rotor bearing is fully seated in housing.

   E. Lubricate new O-rings with dielectric lubricant (see Special Tools in this chapter) and install O-rings into grooves in cover. Place wave washer in cover bearing bore.

   F. Install cover to housing and secure with six (6) flange head screws. Torque screws from **170 to 190 in-lb (19.3 to 21.3 N-m)**.

   G. Make sure that rotor rotates before continuing with generator assembly.

3. Install flocked seal (item 3) (flocked area of seal should be toward generator), wave washer (item 4) and retaining ring (item 5) to generator shaft. Rotate retaining ring to make sure it is seated in shaft groove.

4. Install generator fan:

   A. Make sure that tapered surfaces of rotor shaft and fan are thoroughly clean.

   B. Position woodruff key (item 22) into slot on rotor shaft.

   C. Slide generator fan onto generator shaft.

   D. Secure fan to generator shaft with collar (item 15) and flange head screw (item 16). Torque screw from **170 to 190 in-lb (19.3 to 21.3 N-m)**.

5. Lubricate new O-ring (item 24) with dielectric lubricant (see Special Tools in this chapter) and install into groove on isolator.

6. Install controller onto generator:

   A. Lower controller onto generator and route both controller and generator harness connectors out opening in controller.

   IMPORTANT: When securing stator conductors to controller connectors, make sure that flange head screws do not pinch electrical harnesses.

   B. Loosely install three (3) flange head screws (item 14) that secure generator stator conductors to controller connectors. Make sure that controller and generator harnesses are positioned away from the screws.

   C. Secure controller with cap screws (item 6), flat washers (item 7) and flange nuts (item 10).

   D. Torque three (3) flange head screws (item 14) to **75 in-lb (8.5 N-m)**.

   E. Pack controller harness connector with dielectric lubricant (see Special Tools in this chapter). Plug generator connector into controller connector. Insert harnesses and connectors to the right side of the three (3) terminals in the controller.

7. Lubricate new cover gasket (item 11) with dielectric lubricant (see Special Tools in this chapter). Install gasket into groove in access cover (item 12) and then install cover to controller. Secure cover with two (2) washer head screw (item 13). Torque screws from **70 to 80 in-lb (8.0 to 9.0 N-m)**.

8. Install generator cover (item 17) to generator assembly and secure with washer head screws (item 8). Torque screws from **70 to 80 in-lb (8.0 to 9.0 N-m)**.

9. Secure fan screen (item 20) to generator fan with four (4) torx head screws. Torque screws from **15 to 25 in-lb (1.8 to 2.8 N-m)**.

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Cutting Reel Motor

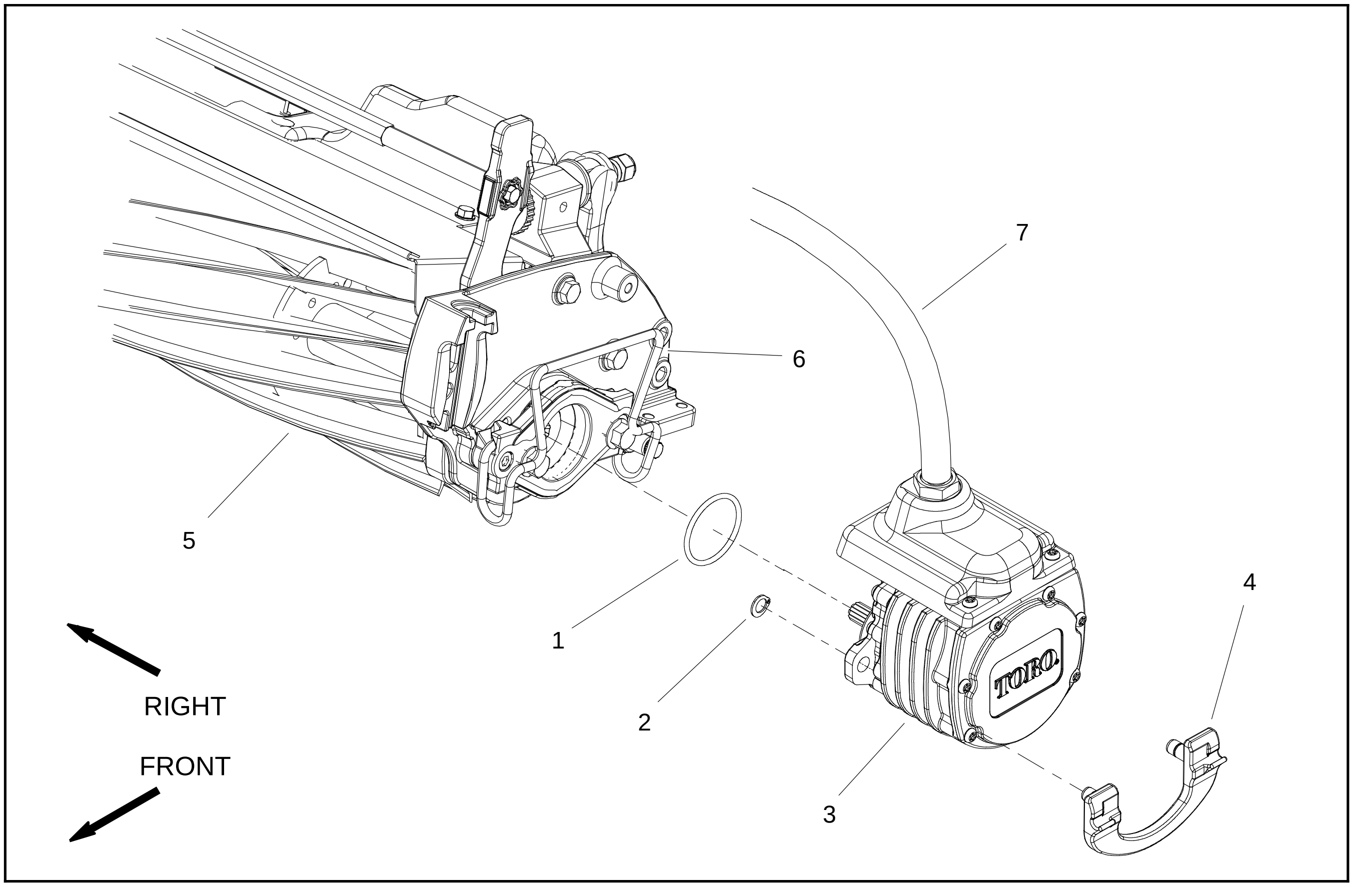

Figure 109

1. **O-ring**
2. **Retaining ring (2 used)**
3. **Cutting reel motor**
4. **Motor mount**
5. **Cutting Unit**
6. **Motor clamp**
7. **Motor cable**

NOTE: If electrical problems exist with a cutting reel motor, a fault should have occurred that would be indicated by a flashing diagnostic light on the console (serial number below 312000000) or fault indicator on the InfoCenter (serial number above 312000000). Before considering that reel motor service work is necessary, check for any existing fault codes that indicate problems with a reel motor.

Removal (Fig. 109)

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Locate and loosen two (2) bulkhead nuts that secure motor cable to brackets on machine. Separate cable from brackets.

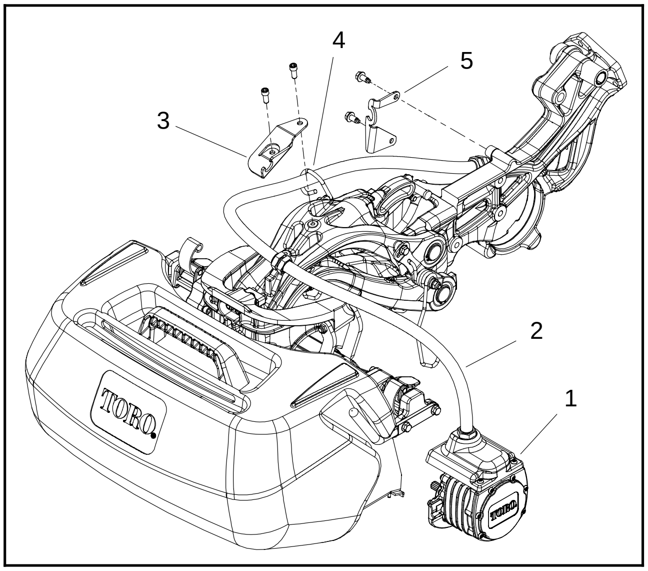

Figure 110

1. **Cutting reel motor**
2. **Motor cable**
3. **Cable bracket**
4. **Wire form**
5. **Cable bracket**

4. Locate and unplug two (2) electrical connectors from motor cable to machine wire harness.

5. Route motor cable out of wire form on cutting unit suspension.

6. Remove cutting reel motor from the cutting unit:

   A. Push the motor clamp out of the slots on the motor mount toward the cutting unit sideplate (Fig. 111).

   B. Slide cutting reel motor from cutting unit (Fig. 112).

7. If necessary, remove two (2) retaining rings that secure motor mount (item 4) to reel motor. Remove motor mount from motor.

Installation (Fig. 109)

1. If motor mount was removed from motor, position motor mount to cutting reel motor flange and secure with two (2) retaining rings.

2. Install cutting reel motor to the cutting unit:

   A. Coat splines of cutting reel motor shaft with clean grease.

   B. Align cutting reel motor shaft splines with splines in cutting reel. Slide reel motor into cutting unit side plate (Fig. 112).

   C. Pull motor clamp toward the motor until clamp fully engages slots on both sides of the motor mount (Fig. 113). There should be an audible click as clamp engages mount.

3. Route motor cable through wire form on cutting unit suspension and then to machine wire harness connectors.

4. Secure motor cable to brackets on machine with two (2) bulkhead nuts.

5. Plug two (2) motor cable electrical connectors into machine wire harness.

6. After completing installation of all cutting unit motors, connect the cutting unit power disconnect couplers.

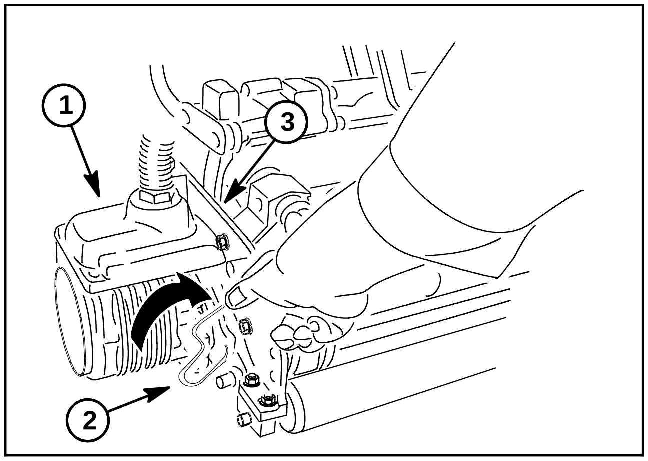

Figure 111

1. **Cutting reel motor**
2. **Motor clamp**
3. **Cutting unit sideplate**

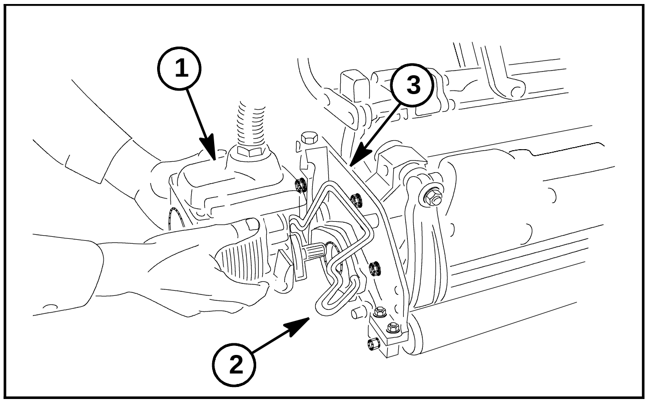

Figure 112

1. **Cutting reel motor**
2. **Motor clamp**
3. **Cutting unit sideplate**

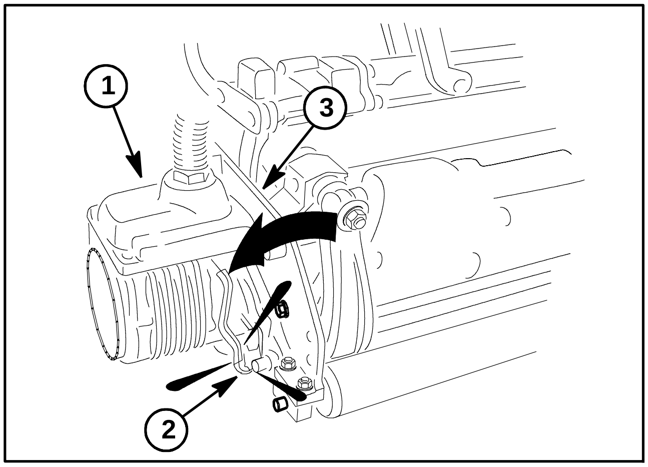

Figure 113

1. **Cutting reel motor**
2. **Motor clamp**
3. **Cutting unit sideplate**

Cutting Reel Motor Service

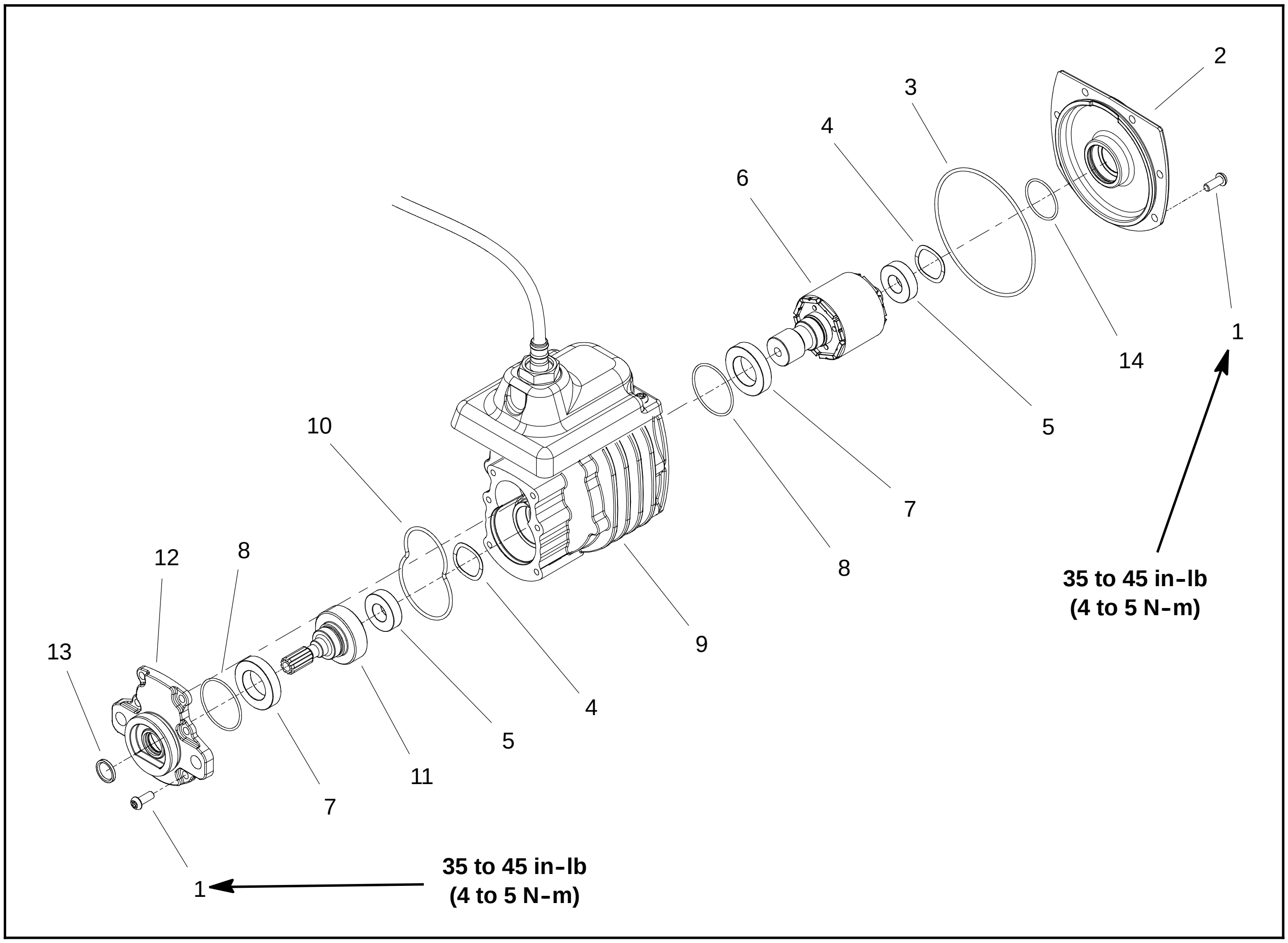

Figure 114

1. **Torx head screw (12 used)**
2. **Motor cover**
3. **O-ring**
4. **Wave washer (2 used)**
5. **Bearing (2 used)**
6. **Rotor**
7. **Bearing (2 used)**
8. **O-ring (2 used)**
9. **Housing/controller/cable assembly**
10. **O-ring**
11. **Output gear**
12. **Gearbox cover**
13. **Shaft seal**
14. **O-ring**

NOTE: If motor housing, controller or cable damage occurs, cutting reel motor replacement is necessary. These components are not available separately.

Disassembly (Fig. 114)

1. Remove six (6) torx head screws that secure gearbox cover (item 12) to front of motor housing.

2. Carefully slide gearbox cover from front of motor.

3. Remove and discard O-rings (items 8 and 10) from gearbox cover.

4. Slide output gear assembly (items 5, 11 and 7) from motor housing. Remove wave washer (item 4).

5. Remove six (6) torx head screws that secure motor cover (item 2) to rear of motor housing. Leave cover on rotor shaft.

IMPORTANT: The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during removal. Be cautious during rotor removal to prevent component damage or personal injury.

6. Use cutting reel motor rotor tool set (see Special Tools in this chapter) to carefully remove rotor assembly (items 5, 6 and 7) and motor cover (item 2) from motor housing.

7. Remove motor cover and wave washer (item 4) from rotor assembly. Remove and discard O-rings (items 14 and 3) from cover.

8. Remove and discard O-ring (item 8) from motor housing.

IMPORTANT: Make sure to not damage the gearbox cover counter bore when removing the shaft seal from the cover.

9. Carefully remove shaft seal from gearbox cover. Discard removed seal.

10. If necessary, remove bearings from output gear (item 11) and rotor (item 6). Discard bearings if removed.

11. Inspect grease in output gear area of motor housing. If grease is clean and not contaminated, it can remain in housing. If grease is contaminated, clean grease from housing and replace with 15ml of NLGI grade 00 grease during motor assembly.

12. Inspect cutting reel motor components for wear or damage. Replace components or cutting unit motor assembly if necessary.

Assembly (Fig. 114)

1. Make sure that motor components are cleaned before assembly.

2. If bearings were removed from output gear (item 11) or rotor (item 6) install new bearings. Make sure that bearings are fully pressed onto shafts.

3. Lubricate new inner O-ring (item 8) with dielectric lubricant (see Special Tools in this chapter) and install O-ring into groove in motor housing.

IMPORTANT: The rotor magnets are very powerful and can cause the rotor to shift position very rapidly during installation. Be cautious during rotor installation to prevent component damage or personal injury.

4. Use cutting reel motor rotor tool set (see Special Tools in this chapter) to carefully install rotor assembly (items 5, 6 and 7) into motor housing.

5. Lubricate new O-rings (items 14 and 3) with dielectric lubricant (see Special Tools in this chapter) and install O-rings to grooves in motor cover. Place wave washer (item 4) in cover.

6. Carefully slide motor cover onto rotor until it contacts motor housing. Secure cover with six (6) torx head screws.

7. Make sure that rotor rotates before continuing with motor assembly.

8. Place wave washer (item 4) into housing bore for output gear bearing.

9. Make sure that output gear area of motor housing has clean grease remaining in housing. If grease was cleaned from housing, install 15ml of new NLGI grade 00 grease into housing during motor assembly.

10. Slide output gear assembly (items 5, 11 and 7) into front of housing. Make sure that output gear teeth mesh with rotor gear.

11. Install shaft seal (item 13) into gearbox cover. Press shaft seal into front cover until it is flush with the cover surface. Shaft seal should have the seal lip toward the inside of the motor (Fig. 115).

12. Lubricate new O-rings (items 8 and 10) with dielectric lubricant (see Special Tools in this chapter) and install O-rings to grooves in gearbox cover.

IMPORTANT: Make sure to not damage the shaft seal when installing the gearbox cover.

13. Carefully slide gearbox cover onto output gear shaft until it contacts motor housing. Secure cover with six (6) torx head screws.

14. Torque all torx screws (item 1) on gearbox cover and motor cover from **35 to 45 in-lb (4 to 5 N-m)**.

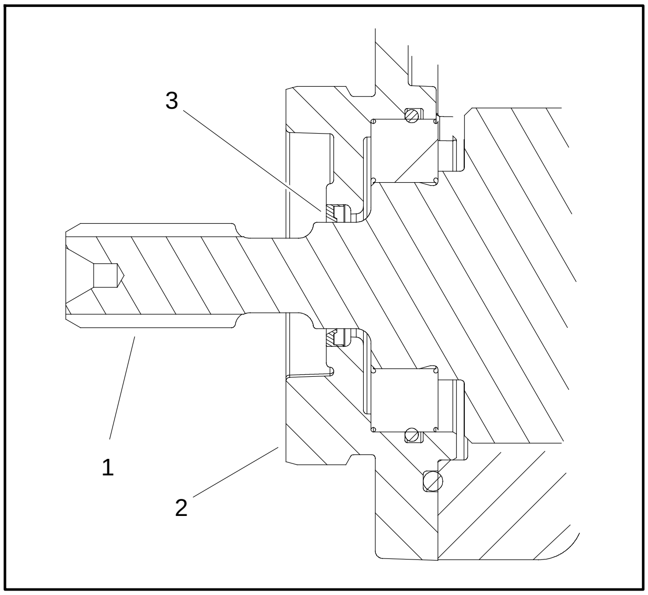

Figure 115

1. **Output gear**
2. **Gearbox cover**
3. **Shaft seal**

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Chapter 7

Chassis

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Specifications

Item	Description
Front tire pressure (19 x 10.50 x 8) (4 ply)	12 to 16 PSI (83 to 110 kPa)
Rear tire pressure (19 x 10.50 x 8) (4 ply)	12 to 16 PSI (83 to 110 kPa)
Wheel lug nut torque	65 to 85 ft-lb (89 to 115 N-m)
Wheel motor/wheel hub lock nut torque	250 to 400 ft-lb (339 to 542 N-m)

General Information

Operator's Manuals

The Traction Unit and Cutting Unit Operator's Manuals provide information regarding the operation, general maintenance procedures and maintenance intervals for your Greensmaster TriFlex Hybrid machine. Refer to these publications for additional information when servicing the machine.

Opening Electrical Circuit to Cutting Units

CAUTION

Before installing, removing or servicing the cutting units, separate the cutting unit power disconnect. This will prevent unexpected cutting unit operation.

Before installing, removing or working on the cutting units, disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (Fig. 1). The couplers are located at the base of the rollover bar on the left side of the traction unit. Connect the couplers together before operating the machine.

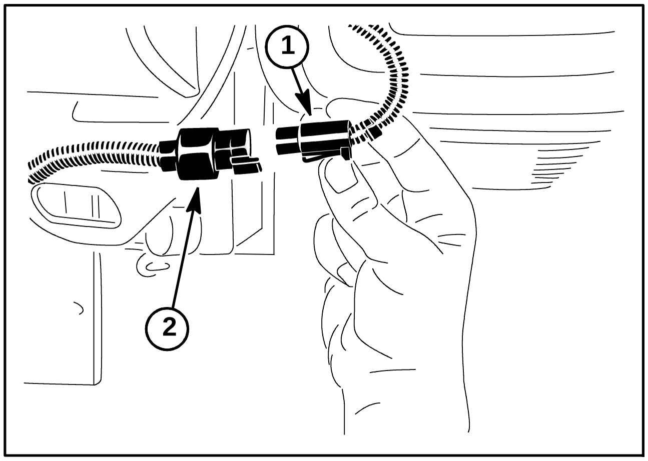

Figure 1

1. **Coupler**
2. **Stationary coupler**

Special Tools

Wheel Hub Puller

The wheel hub puller allows safe removal of the wheel hub from the shaft of the hydraulic wheel motors used on Greensmaster TriFlex Hybrid machines.

Toro Part Number: **TOR4097**

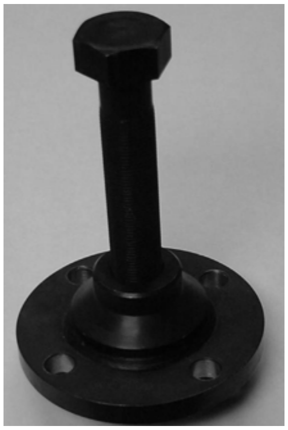

Figure 2

Grease Fitting

This grease fitting can be used to allow the frame tube to be filled with grease after service of the rear steering fork.

Toro Part Number: **302–5**

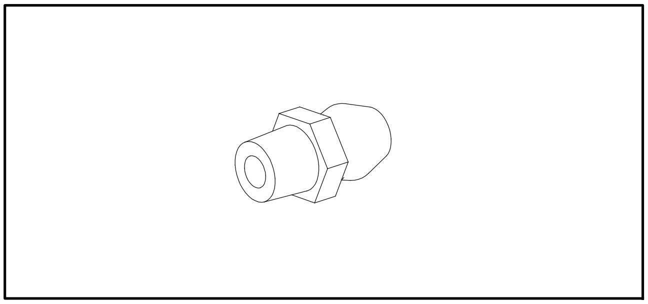

Figure 3

Adjustments

Parking Brake Adjustment

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. With parking brake engaged, measure the distance between the centers of the two (2) pins that secure the brake spring to the brake lever and the equalizer bracket. This distance should be from **6.120” to 6.240” (156 to 158 mm)** (Fig. 4).

3. If necessary, adjust location of brake cable jam nuts at brake cable bracket so that distance between pins is correct.

4. After adjusting parking brake cables, check that brake actuator levers are fully released when parking brake is not applied. Also, when parking brake is not applied, front wheels should rotate freely.

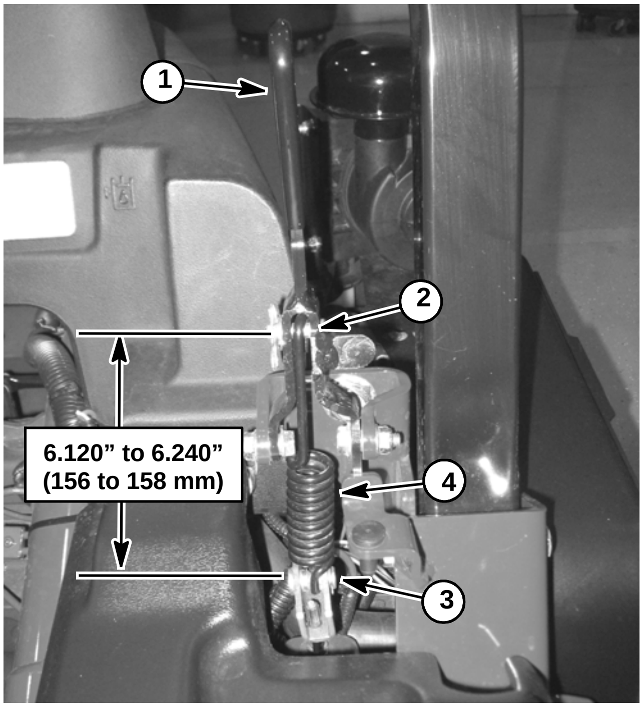

Figure 4

1. Brake lever (engaged)	**3. Equalizer pin**
2. Lever pin	**4. Brake spring**

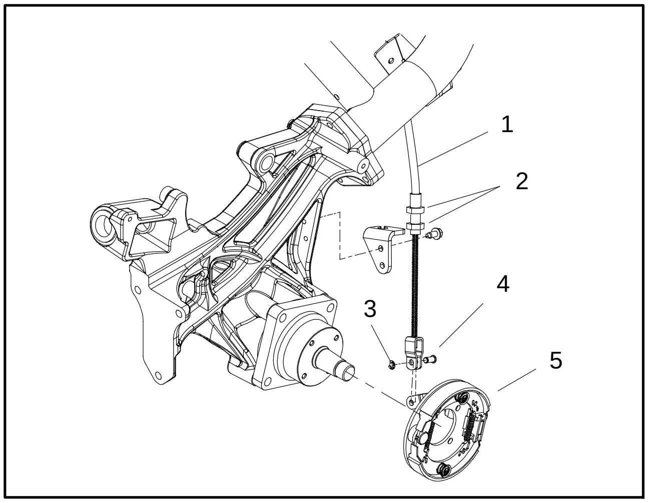

Figure 5

1. Brake cable (RH shown)	**4. Clevis pin**
2. Jam nuts	**5. Brake assembly**
3. E-ring	

Service and Repairs

Wheels

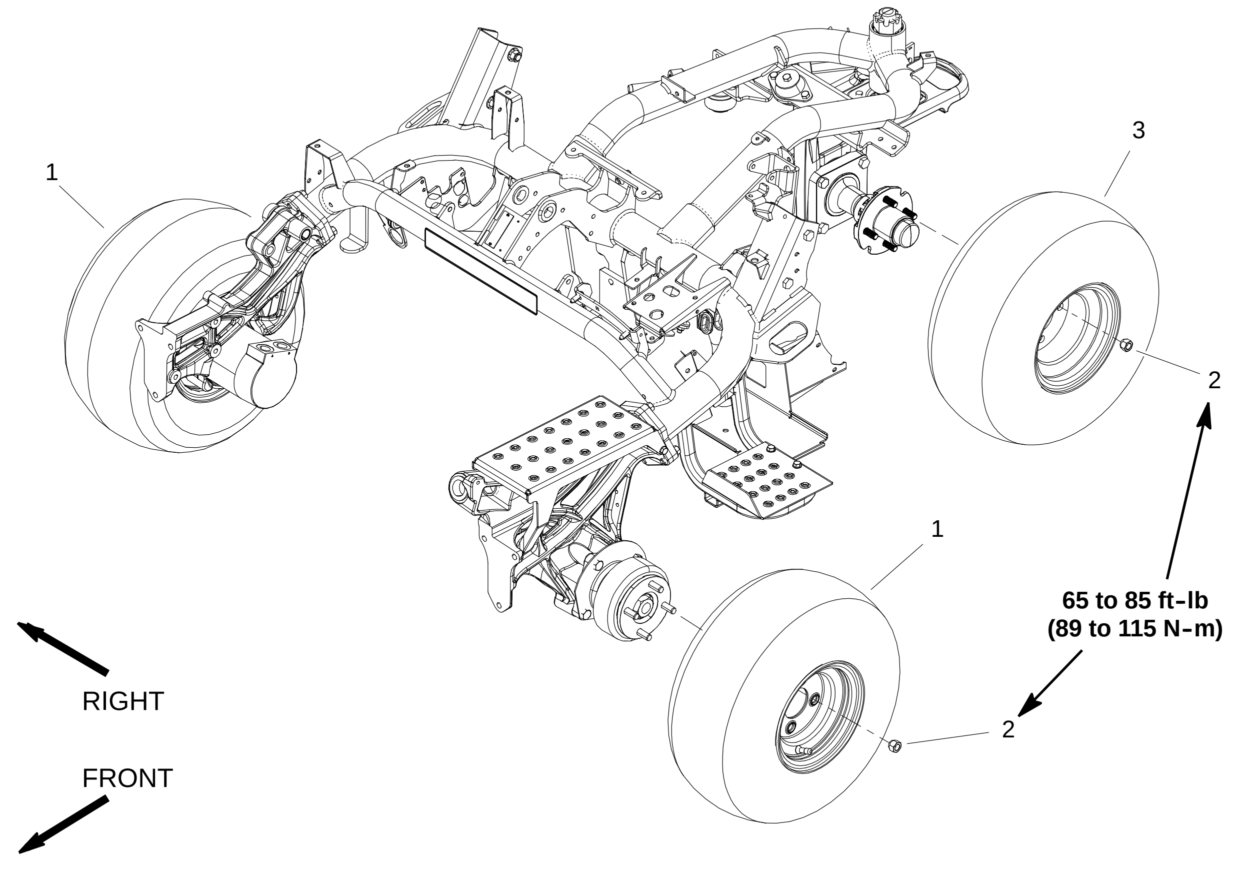
1
3
2
1
65 to 85 ft–lb
(89 to 115 N–m)
2
RIGHT
FRONT

Figure 6

1. **Front wheel**
2. **Lug nut (4 used per wheel)**
3. **Rear wheel**

Removal (Fig. 6)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. Chock wheels to prevent machine from shifting.

3. Loosen, but do not remove, lug nuts.

CAUTION

When changing attachments, tires or performing other service, use correct supports, hoists and jacks. Make sure machine is parked on a solid, level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

4. Using a jack, raise machine so wheel is off ground (see Jacking Instructions in Chapter 1 – Safety). Support machine with appropriate jack stands.

5. Remove lug nuts and then remove wheel from machine.

Installation (Fig. 6)

1. Install wheel and secure with four (4) lug nuts.

2. Lower machine to ground.

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

3. Torque lug nuts evenly in a crossing pattern from **65 to 85 ft–lb (89 to 115 N–m)**.

Brake Service

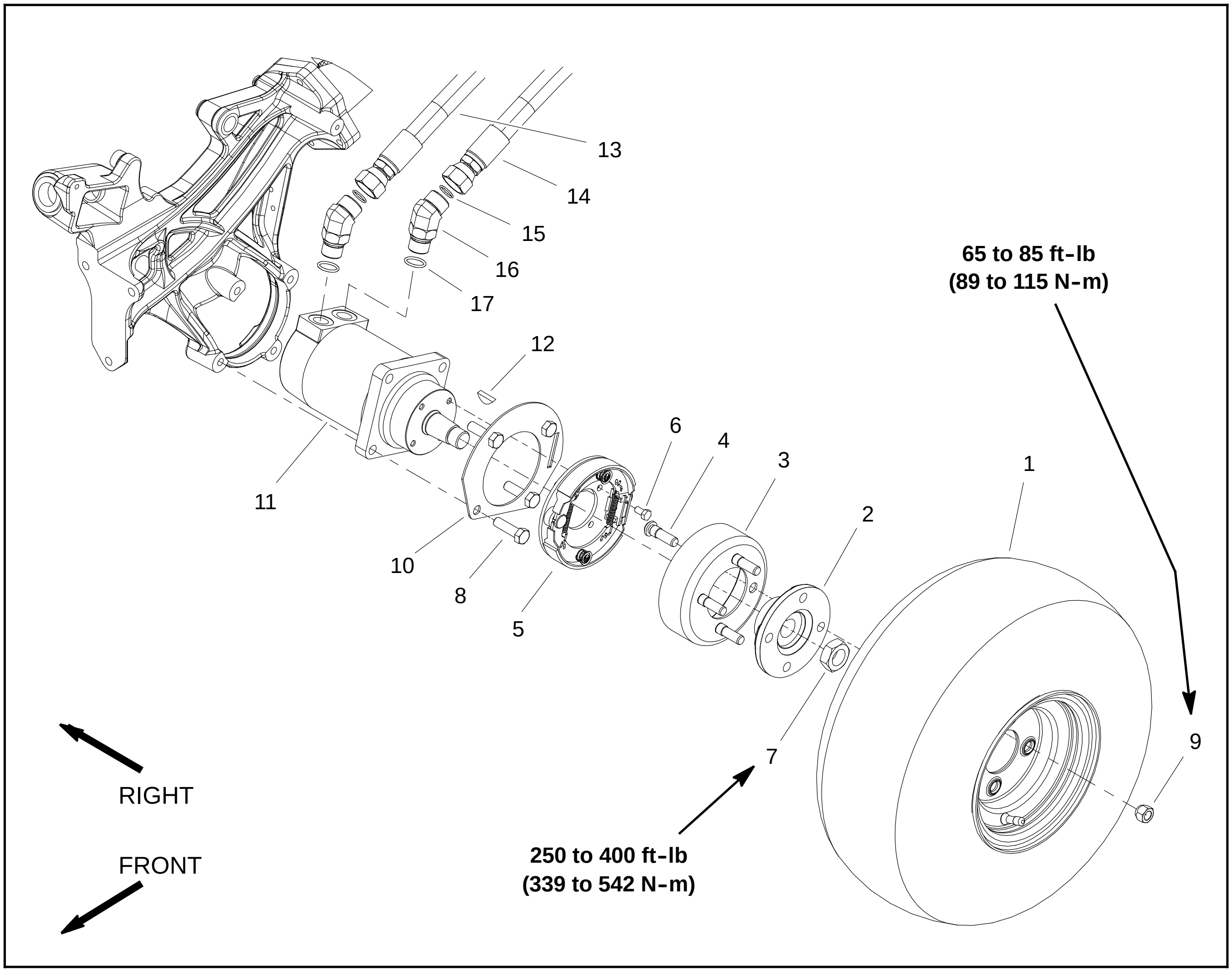

Figure 7

1. **Wheel assembly**
2. **Wheel hub**
3. **Brake drum**
4. **Wheel stud (4 per wheel)**
5. **Brake assembly (LH shown)**
6. **Cap screw (4 per brake)**
7. **Lock nut**
8. **Cap screw (4 per motor)**
9. **Lug nut (4 per wheel)**
10. **Brake lever tab**
11. **Hydraulic motor (LH shown)**
12. **Woodruff key**
13. **Hydraulic hose**
14. **Hydraulic hose**
15. **O-ring**
16. **45º hydraulic fitting (2 per motor)**
17. **O-ring**

Removal (Fig. 7)

1. Park machine on a level surface, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. Chock wheels to prevent machine from shifting.

3. Loosen, but do not remove, lock nut (item 7) from wheel motor shaft.

4. Remove front wheel assembly (see Wheel Removal in this section). Make sure to support machine with jack stands.

5. Make sure parking brake is disengaged.

6. Remove e-ring and clevis pin that secure brake cable to brake actuator lever. Position brake cable end away from lever (Fig. 8).

IMPORTANT: DO NOT hit brake drum assembly, puller or wheel motor with a hammer during drum assembly removal or installation. Hammering may cause damage to the wheel motor.

7. Make sure that lock nut on wheel motor shaft is loosened at least two (2) turns. Use hub puller (see Special Tools) to loosen brake drum assembly from motor.

8. Remove lock nut and brake drum assembly from motor shaft. Discard lock nut. Locate and retrieve woodruff key.

NOTE: If desired, the complete brake assembly can be removed from the machine for disassembly (see step 11 below).

9. Remove shoe springs from brake shoes (Fig. 9).

10. Remove shoe hold down cups and springs. Remove brake shoes and hold down pins from backing plate (Fig. 9).

11. If necessary, remove backing plate from machine by removing four (4) cap screws (item 6).

12. If necessary, press wheel studs from brake drum assembly to allow separation of brake drum and wheel hub.

Installation (Fig. 7)

1. Remove rust and debris from all parts with a wire brush prior to installation. Clean all parts. Inspect brake shoe contact surfaces of the brake drum for excessive wear. Replace any worn or damaged parts.

2. If backing plate was removed from machine, position backing plate to wheel motor with brake lever inserted into slot of brake lever tab. Secure backing plate to wheel motor with four (4) cap screws (item 6).

3. Lightly lubricate brake shoe pivot points with general purpose grease.

4. Position one brake shoe to the backing plate. Install brake hold down pin and secure with hold down spring and cup (Fig. 9). Repeat for second brake shoe.

5. Install shoe springs to brake shoes (Fig. 9). Make sure that brake shoes are properly positioned to pivot and actuator points.

6. If brake drum was separated from wheel hub, align holes in drum and hub. Secure hub to drum by pressing wheel studs into assembly. Make sure that stud shoulders are fully pressed against drum surface.

IMPORTANT: Before brake drum assembly is installed, thoroughly clean tapers of wheel hub and wheel motor shaft. Make sure that tapers are free of grease, oil and dirt. Do not use antiseize lubricant when installing drum assembly.

7. Mount key in the wheel motor shaft, then install the brake drum assembly onto the wheel motor shaft.

8. Install new lock nut (item 7) onto the wheel motor shaft to secure brake drum assembly.

9. Position brake cable end to brake actuator lever. Secure cable to actuator lever with clevis pin and e–ring (Fig. 8).

10. Install front wheel assembly (see Wheel Installation in this section).

11. Lower machine to ground.

WARNING

Failure to maintain proper wheel lug nut and wheel hub lock nut torque could result in failure or loss of wheel and may result in personal injury.

12. Torque lug nuts evenly in a crossing pattern from **65 to 85 ft–lb (89 to 115 N–m)**. Torque lock nut (item 17) that secures wheel hub from **250 to 400 ft–lb (339 to 542 N–m)**.

13. Check and adjust parking brake.

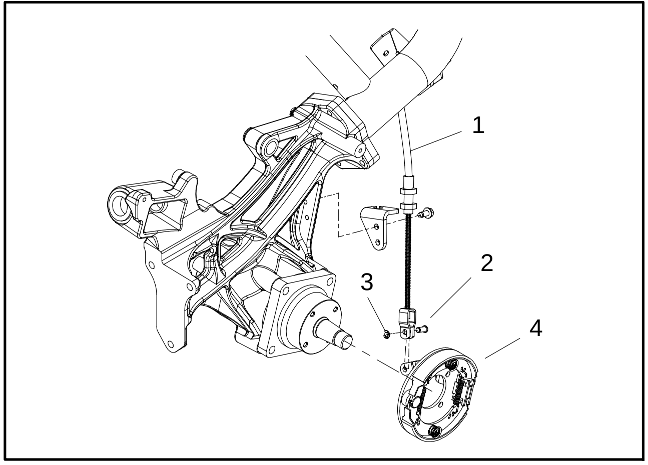

Figure 8

1. **Brake cable (RH shown)**
2. **Clevis pin**
3. **E–ring**
4. **Brake assembly**

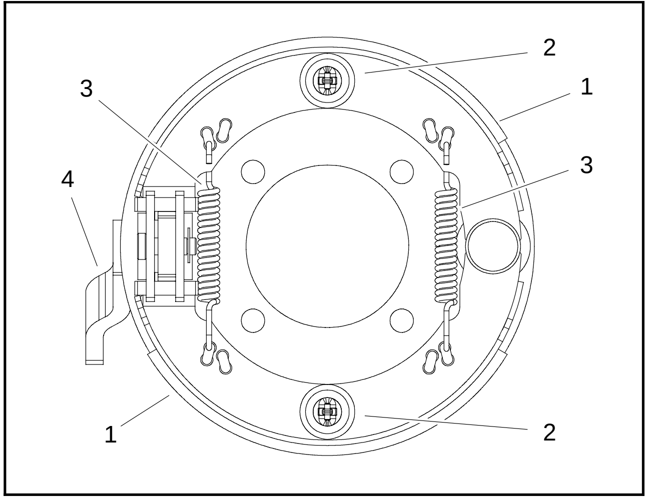

Figure 9

1. **Brake shoe**
2. **Cup, spring and pin**
3. **Shoe spring**
4. **Actuator lever**

Brake Cables

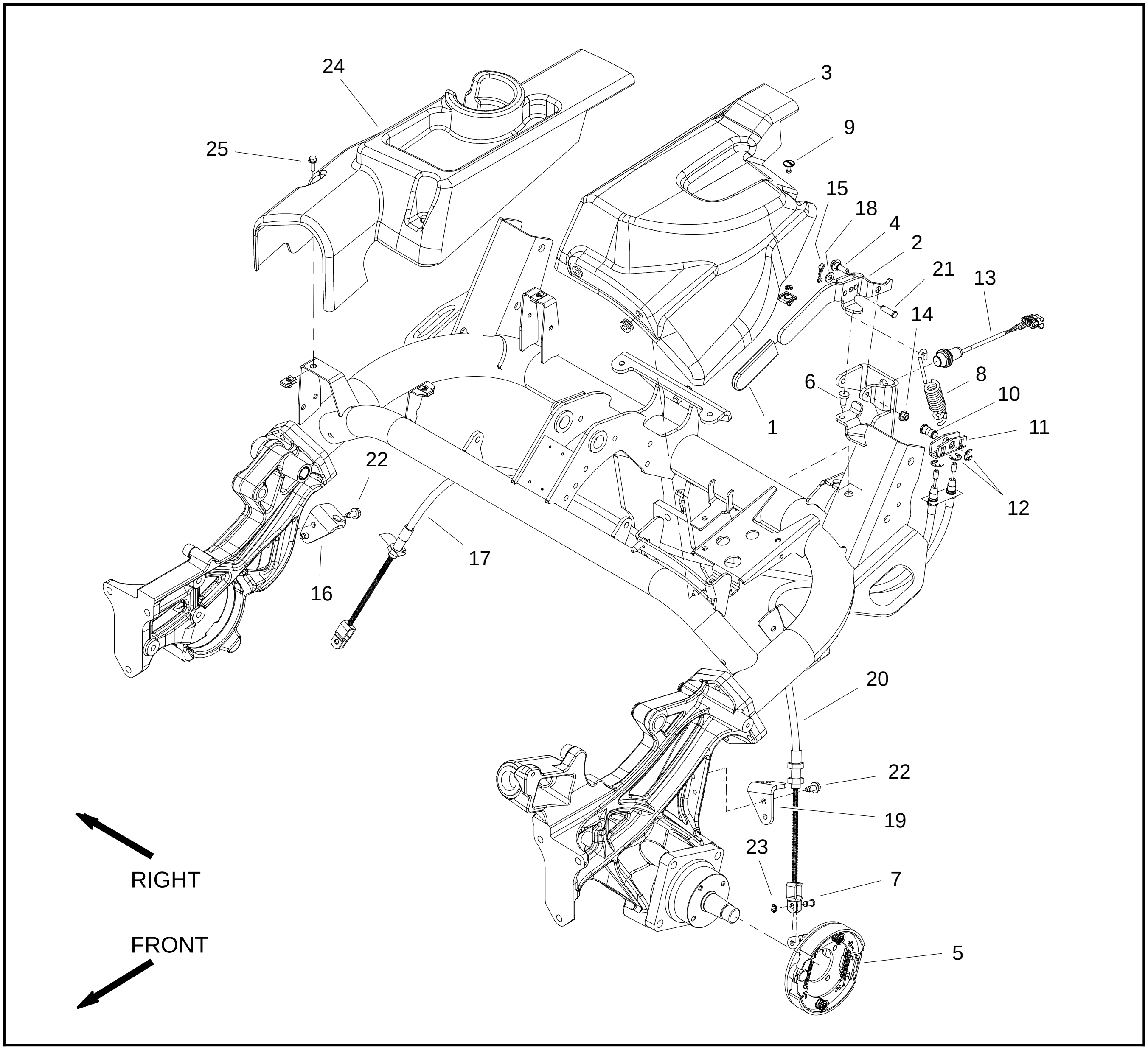
24
3
9
25
15
18
4
2
21
13
14
6
8
10
1
11
22
12
17
16
20
22
19
23
7
RIGHT
FRONT
5

Figure 10

1. **Handle grip**
2. **Brake lever assembly**
3. **LH cover**
4. **Shoulder screw (2 used)**
5. **Brake assembly (LH shown)**
6. **Rubber bumper**
7. **Clevis pin (2 used)**
8. **Extension spring**
9. **Screw**
10. **Pin**
11. **Equalizer bracket**
12. **Retaining ring (3 used)**
13. **Parking brake switch**
14. **Flange nut (2 used)**
15. **Cotter pin**
16. **RH brake cable bracket**
17. **RH brake cable**
18. **Flat washer**
19. **LH brake cable bracket**
20. **LH brake cable**
21. **Yoke pin**
22. **Washer head screw (4 used)**
23. **E–ring (2 used)**
24. **RH cover**
25. **Flange head screw (3 used)**

Brake Cable Removal (Fig. 10)

1. Park machine on a level surface, lower cutting deck (or implement), stop engine and remove key from the ignition switch. Make sure that parking brake is not applied.

2. Chock front wheels to prevent machine from moving.

3. Remove cover(s) (items 3 and 24) from machine to allow access to brake cable that is to be removed.

4. Disconnect brake cable from brake actuator lever:

    A. Remove e–ring (item 23) and clevis pin (item 7) that secure brake cable clevis to brake actuator lever.

    B. At brake cable bracket, loosen upper cable jam nut to allow slack in cable. Then remove lower jam nut from threads on brake cable.

    C. Separate brake cable from brake cable bracket and brake actuator lever.

5. Disconnect brake cable from equalizer bracket at brake lever:

    A. Remove e–ring that secures brake cable to frame bracket.

    B. Remove cable end from equalizer bracket.

    C. Separate brake cable from frame bracket.

6. Note location of cable ties and routing of brake cable for assembly purposes. Remove brake cable from machine.

Brake Cable Installation (Fig. 10)

1. Using notes taken during brake cable removal, route brake cable onto machine. Make sure that parking brake is not applied.

2. Connect brake cable to equalizer bracket at brake lever:

    A. Route brake cable end through hole in frame bracket.

    B. Connect cable end to equalizer bracket.

    C. Secure brake cable to frame bracket with e–ring.

3. Connect brake cable to brake actuator lever:

    A. Position brake cable clevis to brake actuator lever. Secure cable to actuator lever with clevis pin (item 7) and e–ring (item 23).

    B. Route end of brake cable through brake cable bracket.

    C. Install lower jam nut onto brake cable threads.

4. Secure brake cables to machine with cable ties in locations noted during cable removal.

5. Adjust brake cables (see Parking Brake Adjustment in the Adjustments section of this chapter).

6. If removed, install cover(s) (items 3 and 24) to machine.

7. After brake cables have been installed and adjusted, make sure to check operation of parking brake and brake interlock system.

Rear Wheel Spindle Assembly

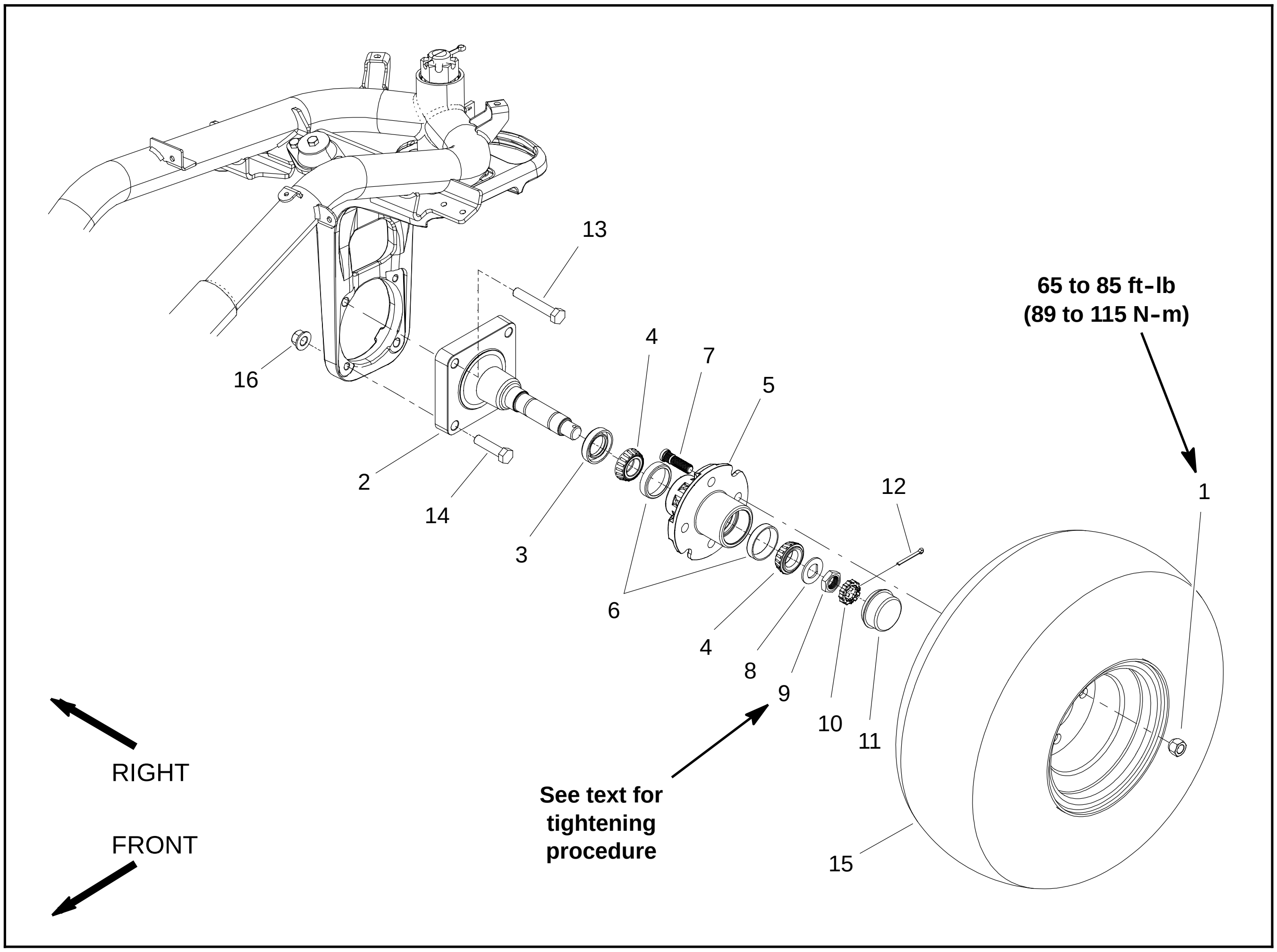
13
65 to 85 ft–lb
(89 to 115 N–m)
4
7
5
16
2
14
3
12
1
6
4
8
9
10
11
RIGHT
FRONT
See text for
tightening
procedure
15

Figure 11

1. **Lug nut (4 used)**
2. **Wheel spindle**
3. **Seal**
4. **Bearing cone (2 used)**
5. **Wheel hub**
6. **Bearing cup (2 used)**
7. **Wheel stud (4 used)**
8. **Tab washer**
9. **Jam nut**
10. **Retainer**
11. **Dust cap**
12. **Cotter pin**
13. **Cap screw (2 used)**
14. **Cap screw (2 used)**
15. **Rear wheel assembly**
16. **Flange nut (2 used)**

Disassembly (Fig. 11)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. Chock front wheels to prevent machine from shifting.

3. Remove rear wheel (see Wheel Removal in this section). Make sure to support machine with jack stands.

4. Remove the dust cap from the wheel hub.

5. Remove the cotter pin, retainer, jam nut and tab washer. Slide the wheel hub from the spindle shaft.

6. Pull the seal out of the wheel hub. Discard seal.

7. Remove the bearing cones from both sides of the wheel hub. Clean the bearings in solvent. Make sure the bearings are in good operating condition. Clean the inside of the wheel hub. Check the bearing cups for wear, pitting or other damage. Replace worn or damaged parts.

8. If necessary, press wheel studs from wheel hub.

9. Inspect wheel spindle for wear or damage. If required, remove cap screws and flange nuts that secure spindle to rear fork and remove spindle from machine.

Assembly (Fig. 11)

1. If wheel spindle was removed from rear fork, position spindle to fork and secure with cap screws and flange nuts.

2. If bearing cups were removed from the wheel hub, press new cups into the hub until they seat against the shoulder of the hub.

3. If wheel studs were removed from wheel hub, press wheel studs into hub. Make sure that stud shoulders are fully pressed against hub surface.

4. Apply a light coating of grease to wheel spindle.

5. Pack both bearing cones with grease. Install one bearing into the bearing cup on inboard side of the wheel hub.

IMPORTANT: The lip of the seal must be toward the bearing. The seal should be pressed in so it is flush with the end of the wheel hub.

6. Lubricate the inside of a new seal and press it into the wheel hub with the seal lip toward the bearing.

7. Fill wheel hub cavity between bearings approximately 50% full of grease. Position remaining bearing into the outer bearing cup.

8. Carefully slide the wheel hub assembly onto the spindle shaft and secure it in place with the tab washer and jam nut. DO NOT fully tighten the nut or install the cotter pin.

9. While rotating the wheel hub by hand, torque the jam nut from 75 to 100 in-lb (8.5 to 11.3 N–m) to set the bearings. Then, loosen the nut until the hub has endplay.

10. Again, while rotating the wheel hub by hand, torque the jam nut from **15 to 20 in-lb (1.7 to 2.3 N–m)**. After tightening, make sure that the wheel hub does not have any free play.

11. Install retainer with slot aligned to cotter pin hole in spindle. Install cotter pin.

12. Fill dust cap approximately half full of grease. Install dust cap.

13. Install rear wheel (see Wheel Installation in this section).

14. Lower machine to ground.

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

15. Torque lug nuts evenly in a crossing pattern from **65 to 85 ft–lb (89 to 115 N–m)**.

Rear Steering Fork

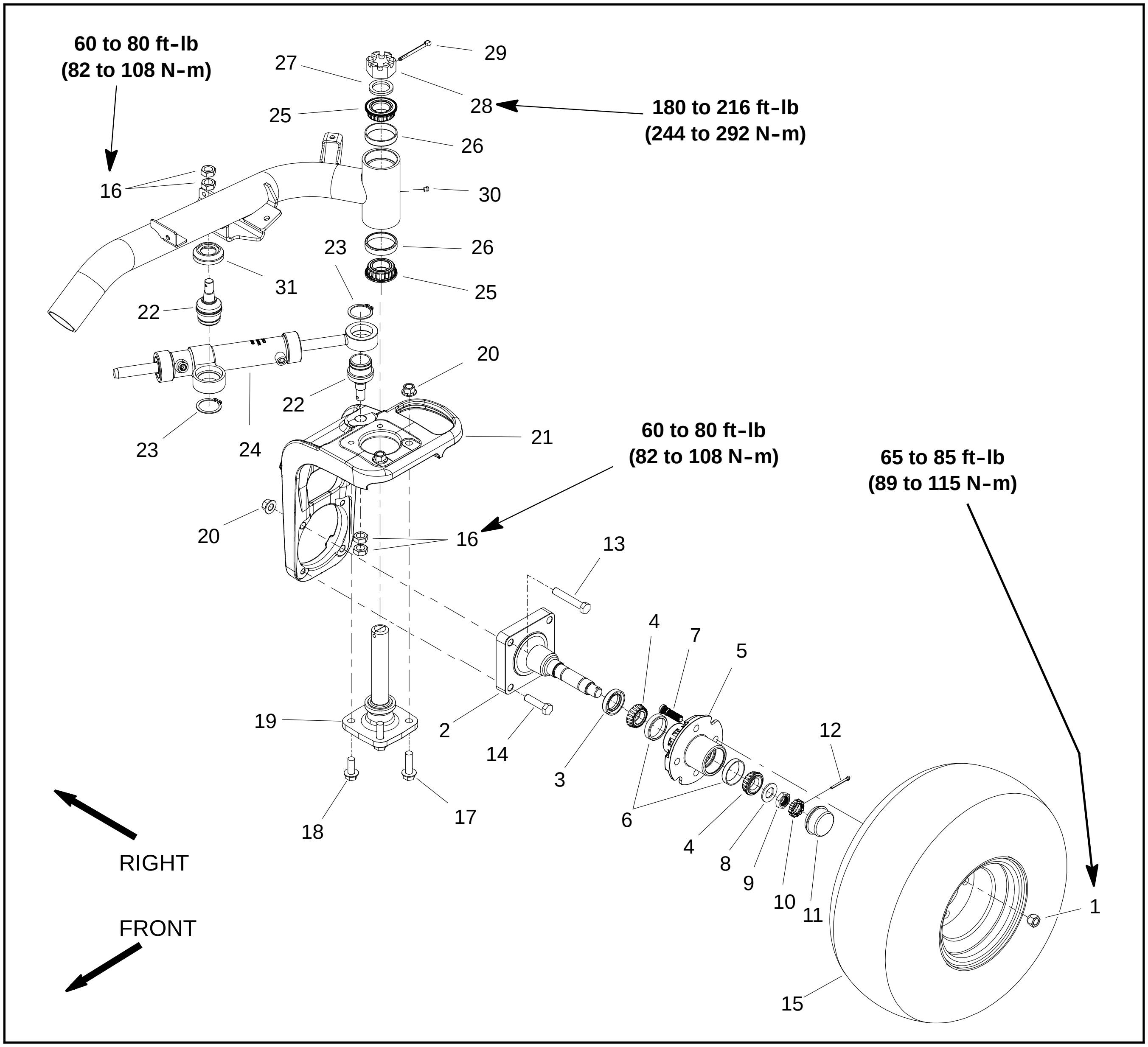
60 to 80 ft-lb
(82 to 108 N-m)
180 to 216 ft-lb
(244 to 292 N-m)
60 to 80 ft-lb
(82 to 108 N-m)
65 to 85 ft-lb
(89 to 115 N-m)
RIGHT
FRONT
1
2
3
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Figure 12

1. **Lug nut (4 used)**
2. **Wheel spindle**
3. **Seal**
4. **Bearing cone (2 used)**
5. **Wheel hub**
6. **Bearing cup (2 used)**
7. **Wheel stud (4 used)**
8. **Tab washer**
9. **Jam nut**
10. **Retainer**
11. **Dust cap**
12. **Cotter pin**
13. **Cap screw (2 used)**
14. **Cap screw (2 used)**
15. **Rear wheel assembly**
16. **Jam nut (4 used)**
17. **Flange head screw (2 used)**
18. **Flange head screw (2 used)**
19. **Steering spindle**
20. **Flange nut (4 used)**
21. **Rear steering fork**
22. **Ball joint (2 used)**
23. **Retaining ring (2 used)**
24. **Steering cylinder**
25. **Bearing cone (2 used)**
26. **Bearing cup (2 used)**
27. **Steering washer**
28. **Slotted hex nut**
29. **Cotter pin**
30. **Plug**
31. **Cylinder spacer**

Removal (Fig. 12)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. To allow access to rear steering fork, remove tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) from machine (see Tank Mount Plate Assembly in this section).

3. Chock front wheels to prevent machine from shifting.

4. Loosen, but do not remove, rear wheel lug nuts.

5. Jack up rear of machine and support machine with jack stands (see Jacking Instructions in Chapter 1 – Safety).

6. Remove rear wheel assembly (see Wheel Removal in this section).

7. Remove two (2) jam nuts that secure steering cylinder rod end to the rear steering fork. Separate steering cylinder rod end from the steering fork.

8. If machine is equipped with optional 3WD kit, remove rear wheel motor from rear steering fork (see Rear Wheel Motor (Optional 3WD) Removal in the Service and Repairs section of Chapter 5 – Hydraulic System). Carefully, position wheel motor assembly away from steering fork taking care to not damage hydraulic lines.

9. Support rear steering fork assembly to prevent it from falling.

CAUTION

Support rear steering fork assembly when removing it to prevent it from falling and causing personal injury. Assembly weighs approximately 25 pounds (11 kg).

10. Remove cotter pin (item 29) and slotted hex nut (item 28) that secure the steering fork spindle into the frame tube. Slide the rear steering fork assembly out of the frame. Locate and retrieve steering washer (item 27) and both bearing cones (item 25).

11. Clean the bearing cones and make sure the bearings are in good condition. Clean the inside of the frame tube. Check the bearing cups for wear, pitting or other damage. Replace worn or damaged parts.

12. If necessary, remove wheel spindle assembly from rear steering fork. Cut–outs in wheel hub will allow access to cap screws that secure spindle assembly to steering fork.

13. Thoroughly clean the steering fork spindle. Inspect the spindle for wear and replace steering spindle (item 19) if spindle is worn or damaged.

Installation (Fig. 12)

1. If bearing cups were removed from the frame tube, press new cups into the tube until they seat against the shoulder of the frame.

2. Apply a light coating of grease to steering fork spindle.

3. Pack both bearing cones with grease. Install one bearing onto the steering spindle.

4. Install steering fork assembly into frame:

   A. Insert steering fork spindle up through frame tube.

   B. Hold the steering fork in place. Install the steering washer and upper bearing cone onto the spindle.

   C. Secure steering fork in frame with slotted hex nut (item 28). Torque nut from **180 to 216 ft–lb (244 to 292 N–m)** so that slot in nut aligns with hole in shaft.

   D. Install cotter pin.

   E. Remove plug (item 30) from back of frame tube and temporarily install grease fitting (Toro part #302–5 or equivalent). Fill frame tube with grease until grease is seen exiting at both ends of the tube. Wipe up excess grease. Remove grease fitting and reinstall plug in frame.

5. If machine is equipped with optional 3WD kit, install rear wheel motor to rear steering fork (see Rear Wheel Motor (Optional 3WD) Installation in the Service and Repairs section of Chapter 5 – Hydraulic System).

6. If wheel spindle assembly was removed from rear steering fork, secure spindle assembly to steering fork. Cut–outs in wheel hub will allow access to cap screws that secure spindle assembly to steering fork.

7. Insert the steering cylinder rod end into the rear steering fork.

8. Secure steering cylinder to steering fork with two (2) jam nuts (item 16). Install first jam nut and torque from **60 to 80 ft–lb (82 to 108 N–m)**. Then, while holding first jam nut with wrench, tighten second jam nut and torque from **60 to 80 ft–lb (82 to 108 N–m)**.

9. Install rear wheel assembly (see Wheel Installation in this section).

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

10. Lower machine to ground and make sure that lug nuts are torqued evenly in a crossing pattern from **65 to 85 ft–lb (89 to 115 N–m)**.

11. Install tank mount plate assembly to machine (see Tank Mount Plate Assembly in this section).

Control Console

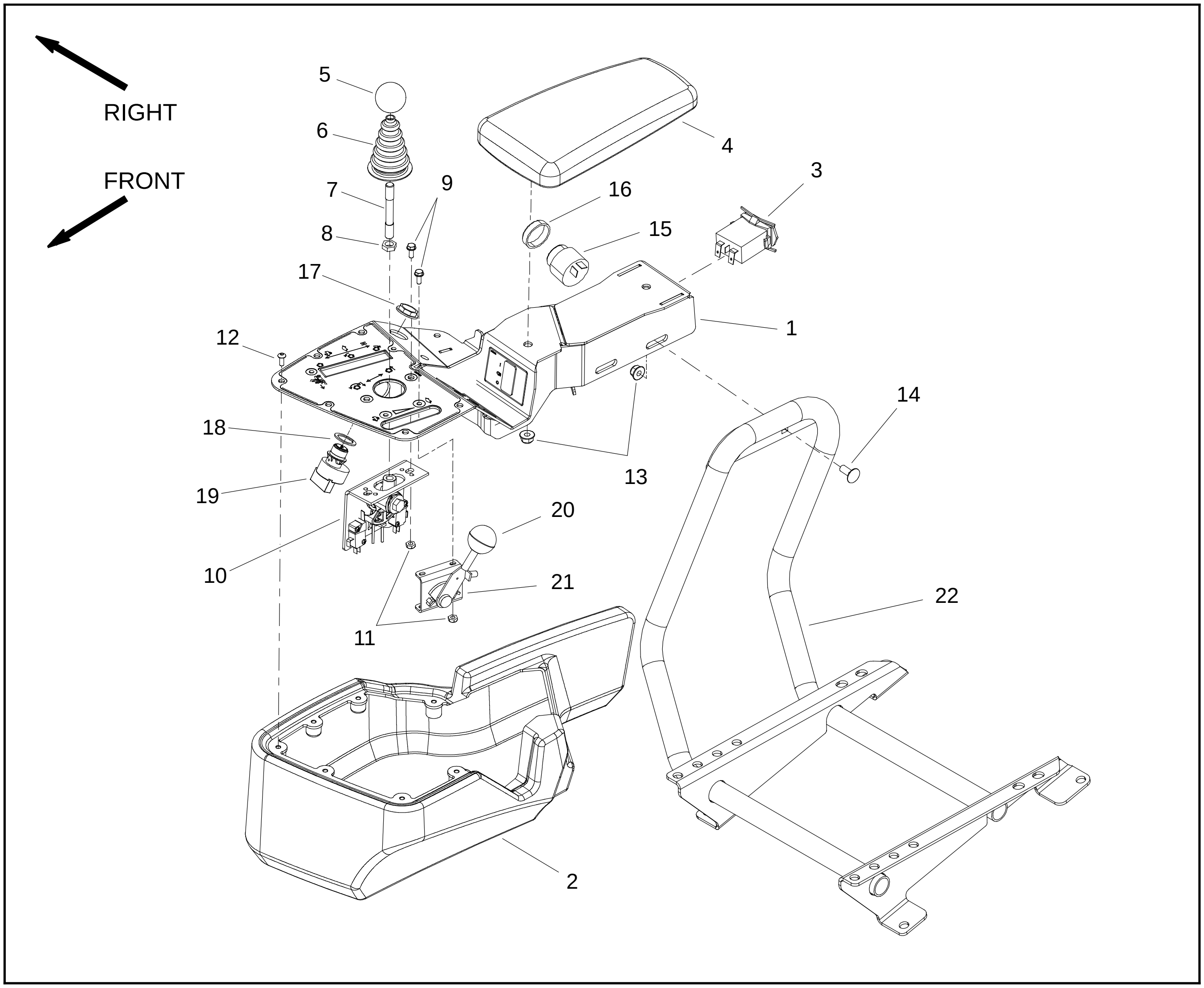
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Figure 13

1. **Console**
2. **Console cover**
3. **Hour meter**
4. **Arm rest**
5. **Knob**
6. **Lever boot**
7. **Joystick rod**
8. **Jam nut**
9. **Washer head screw (2 per control)**
10. **Joystick assembly**
11. **Lock nut (2 per control)**
12. **Screw (7 used)**
13. **Flange nut (4 used)**
14. **Carriage screw (2 used)**
15. **Alarm (if equipped)**
16. **Alarm nut (if equipped)**
17. **Nut**
18. **Washer**
19. **Ignition switch**
20. **Knob**
21. **Throttle control**
22. **Console support (standard seat)**

Disassembly (Fig. 13)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. Remove screws (item 12) that secure console cover (item 2) to console. Lower cover to allow access to console components.

3. Remove components from control console as needed using Figure 13 as a guide.

4. Disassemble functional control lever assembly as needed using Figure 14 as a guide.

5. Disassemble joystick assembly as needed using Figure 15 as a guide.

NOTE: The alarm (item 15) is used on machines that are equipped with the Turf Guardian^{TM} Leak Detector System.

NOTE: Refer to Chapter 6 – Electrical System for information regarding electrical components on console.

Assembly (Fig. 13)

1. If functional control lever assembly was disassembled, assemble control lever using Figure 14 as a guide.

2. If joystick assembly was disassembled, assemble joystick using Figure 15 as a guide. If finger spring washers (item 7 in Fig. 15) were removed, position washers so that fingers on washer point towards pivot hub.

3. Install all removed components to control console using Figure 13 as a guide.

4. Position console cover (item 2) to console and secure with screws (item 12).

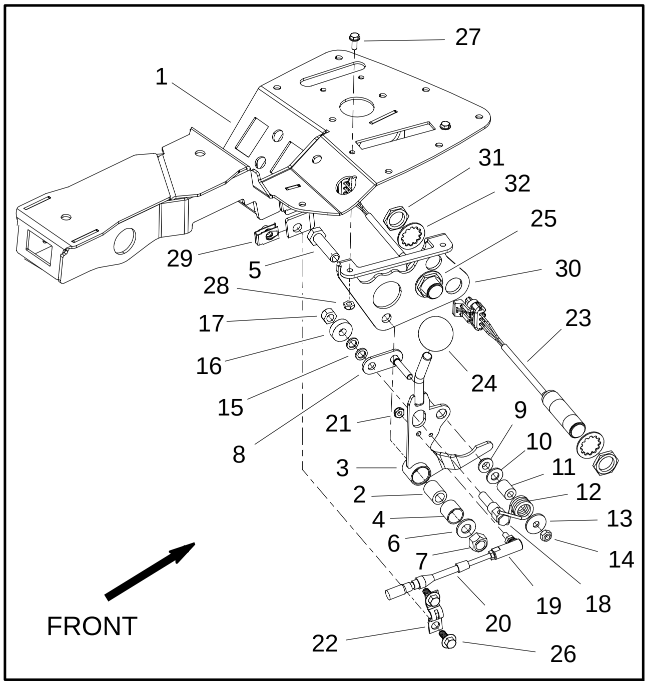


Figure 14

1. Console
2. Pivot tube
3. Functional lever
4. Split bushing
5. Cap screw
6. Flat washer
7. Lock nut
8. Roller pivot
9. Bushing
10. Flat washer
11. Spring spacer
12. Torsion spring
13. Flat washer
14. Lock nut
15. Bearing spacer (2 used)
16. Bearing
17. Lock nut
18. Spring pin
19. Ball joint
20. Neutral lock cable
21. Lock nut
22. Cable clamp
23. Neutral switch
24. Knob
25. Mow switch
26. Screw (2 used)
27. Screw (2 used)
28. Lock nut (2 used)
29. Clip (2 used)
30. Lever bracket
31. Jam nut (4 used)
32. Lock washer (4 used)

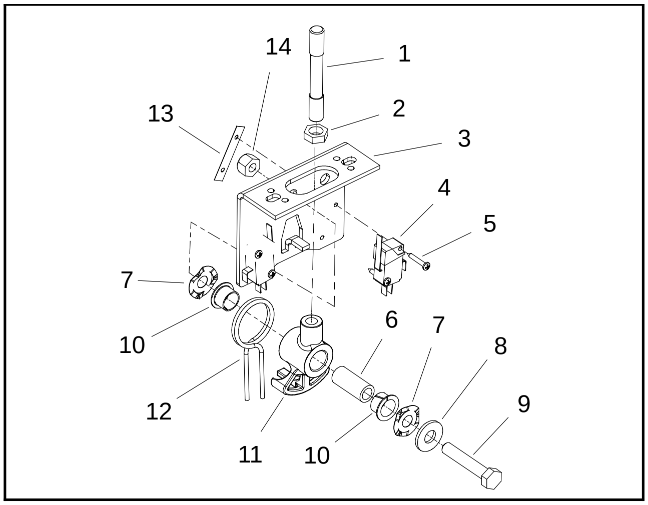


Figure 15

1. Joystick rod
2. Jam nut
3. Joystick bracket
4. Switch (2 used)
5. Screw (2 per switch)
6. Spacer
7. Finger spring washer
8. Flat washer
9. Cap screw
10. Bushing
11. Pivot hub
12. Torsion spring
13. Speed nut (2 used)
14. Lock nut

Tank Mount Plate Assembly

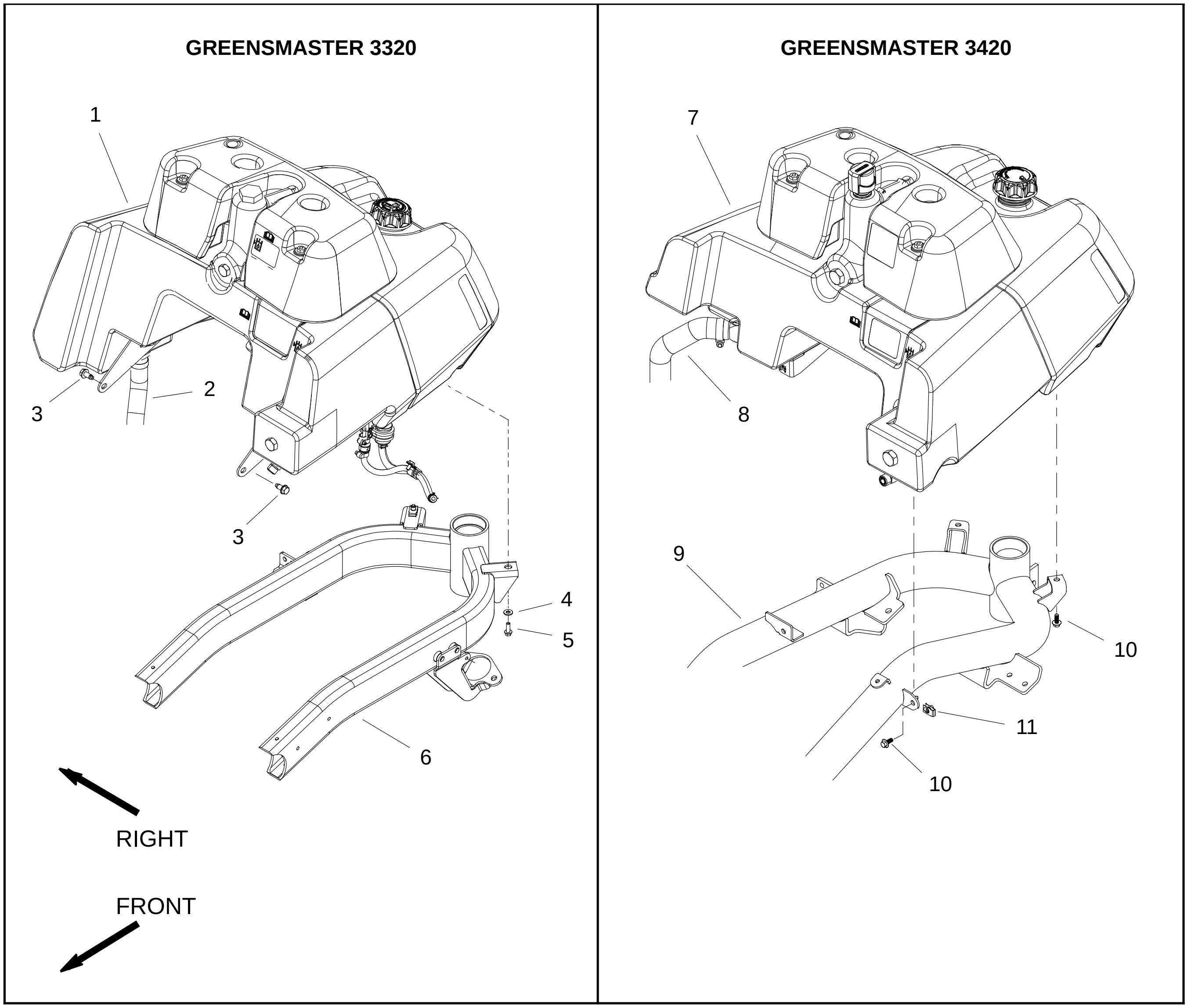


Figure 16

1. **Tank mount plate assembly (GR3320)**
2. **Suction hose (to gear pump)**
3. **Flange head screw (2 used)**
4. **Flat washer (2 used)**
5. **Flange head screw (2 used)**
6. **Frame**
7. **Tank mount plate assembly (GR3420)**
8. **Suction hose (to gear pump)**
9. **Frame**
10. **Flange head screw (4 used)**
11. **Clip (2 used)**

NOTE: For access to fasteners that secure hydraulic reservoir and fuel tank and also to access machine components at rear of machine (e.g. steering cylinder, rear steering fork), the tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) can be raised and supported. If necessary, the complete tank mount plate assembly can be removed from the machine.

CAUTION

Before disconnecting any hydraulic hoses, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in the Service and Repairs section of Chapter 5 – Hydraulic System.

Raise Tank Mount Plate Assembly (Fig. 16)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. Locate and remove four (4) screws that secure tank mount plate to frame.

3. Carefully lift tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) up from machine. Take care to not damage fuel lines, hydraulic hoses or electrical components as assembly is raised. Support mount plate assembly in a raised position to allow access to machine components.

4. If additional clearance below the tank mount plate assembly is desired, the suction hose can be clamped and disconnected from the gear pump:

   A. Clamp suction hose to prevent draining the hydraulic tank.

   B. Thoroughly clean junction of suction hose and gear pump inlet fitting.

   C. Disconnect suction hose from gear pump inlet fitting.

   D. Carefully raise and support the tank mount plate assembly.

5. After completing service work below the tank mount plate assembly, carefully lower assembly to machine frame. Secure assembly to frame with removed screws. If suction hose was disconnected from gear pump, connect hose to pump fitting and secure with hose clamp.

Remove Tank Mount Plate Assembly (Fig. 16)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. Completely drain hydraulic oil from hydraulic reservoir through gear pump suction hose into a suitable container.

3. Disconnect hydraulic hoses from fittings on hydraulic tank. Put clean caps or plugs on hoses and fittings.

4. Close fuel shut off valve on fuel tank.

5. Disconnect additional fuel system hoses:

   A. On Greensmaster 3320 machines, disconnect hose from fuel filter that is located next to rear cylinder head (Fig. 17). Also, disconnect fuel evaporative system hoses as needed to allow tank mount plate to be removed from machine (see Fuel Evaporative Control System in Chapter 3 – Gasoline Engine).

   B. On Greensmaster 3420 machines, disconnect fuel supply hose from shut off valve on fuel tank and fuel return hose from hose splicer fitting above radiator. Also, remove vent hose from grommet in engine support.

6. If machine is equipped with the Turf Guardian™ Leak Detector System, disconnect wire harness connectors from oil level sensor and solenoid coil.

7. Remove four (4) screws that secure tank mount plate to frame.

8. Lift tank mount plate assembly (hydraulic reservoir, fuel tank and tank mount plate) from machine.

9. After completing service work below the tank mount plate assembly, install assembly to machine:

   A. Carefully position tank mount plate assembly to machine frame. Secure assembly to frame with removed screws.

   B. Connect and secure all hydraulic hoses (see Hydraulic Hose and Tube Installation in the General Information section of Chapter 5 – Hydraulic System).

   C. Connect and secure all fuel hoses. Open fuel shut off valve on fuel tank.

   D. If machine is equipped with the Turf Guardian™ Leak Detector System, connect wire harness connectors to oil level sensor and solenoid coil.

   E. Fill hydraulic reservoir with new hydraulic oil.

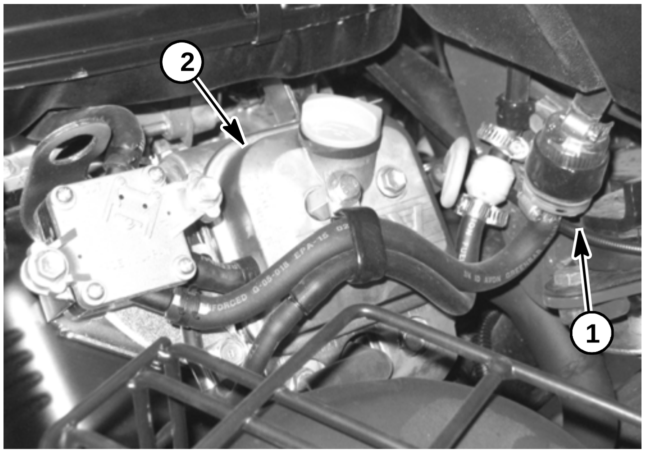


Figure 17

1. **Fuel filter**
2. **Rear cylinder head**

Cutting Unit Suspension Crossarm Assembly

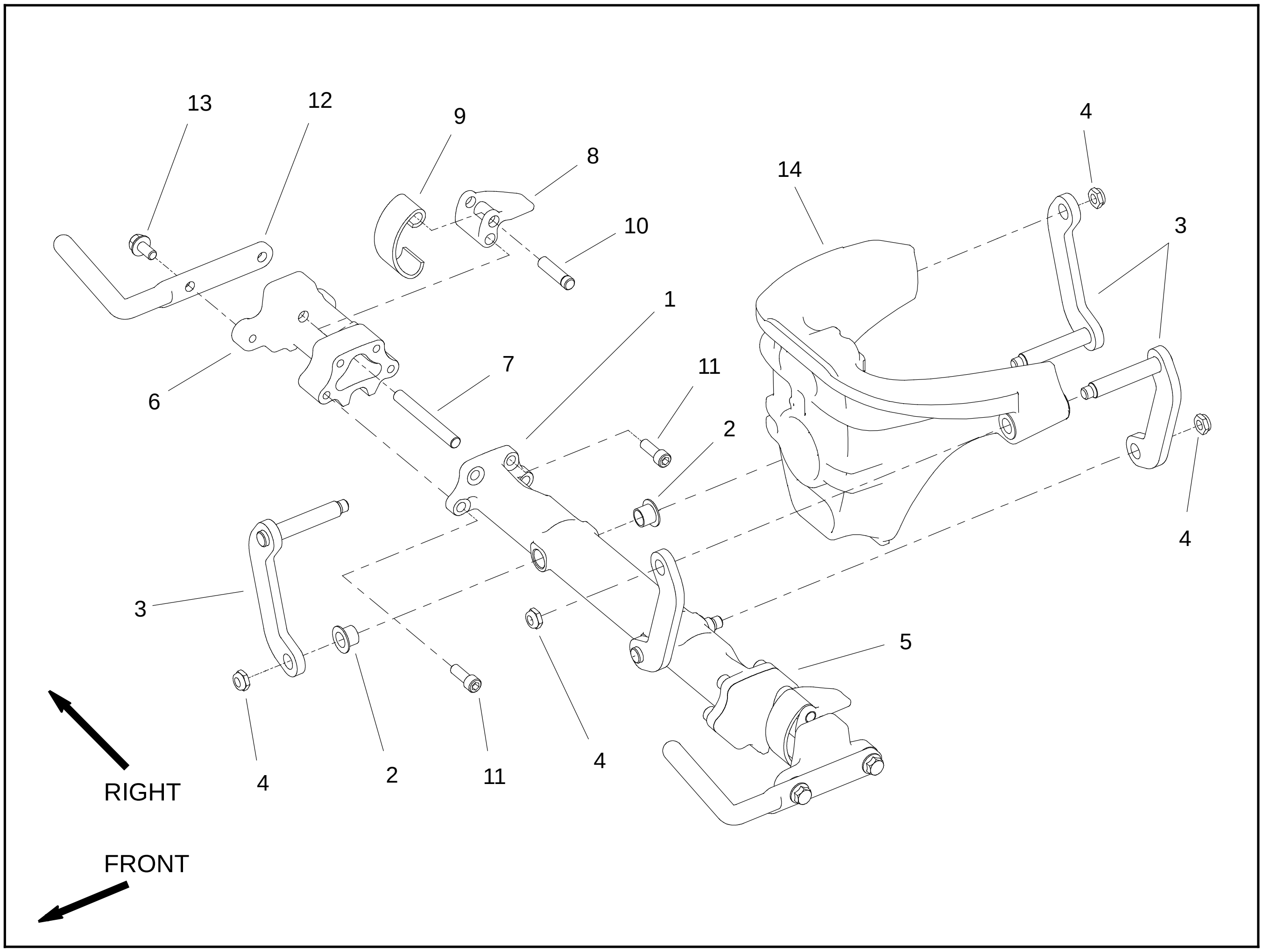


Figure 18

1. **Crossarm**
2. **Flange bushing (4 used)**
3. **Link (4 used)**
4. **Lock nut (4 used)**
5. **LH crossarm mount**
6. **RH crossarm mount**
7. **Pivot pin (2 used)**
8. **Lever (2 used)**
9. **Spring (2 used)**
10. **Pivot pin (2 used)**
11. **Socket head screw (8 used)**
12. **Basket horn (2 used)**
13. **Flange head screw (4 used)**
14. **Suspension steering head**

NOTE: Three (3) identical cutting unit suspension assemblies are used on Greensmaster TriFlex machines. The cutting unit attaches to the crossarm assembly which is attached to the front of the cutting unit suspension assembly.

Disassembly (Fig. 18)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter).

3. Remove grass basket from suspension assembly.

4. Remove cutting unit from suspension assembly (see Traction Unit Operator's Manual).

5. Disassembly crossarm assembly as required using Figure 18 as a guide.

NOTE: The flange head screws (item 13) used to secure the basket horn (item 12) to the crossarm assembly have a patch lock to prevent loosening of the screws. If screws are removed, replace screws.

Assembly (Fig. 18)

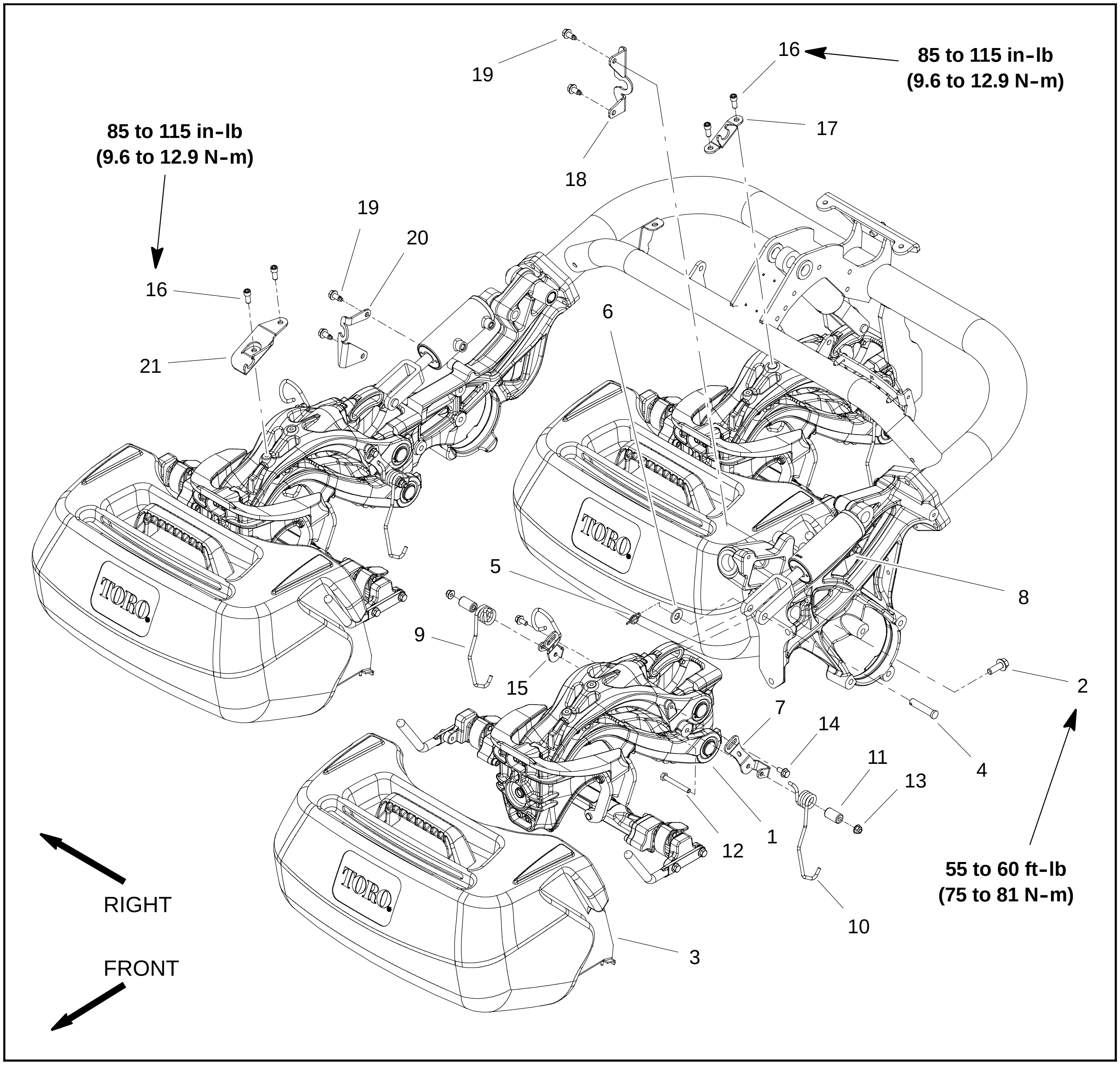
1. Assemble crossarm assembly using Figure 18 as a guide.

2. Install cutting unit to suspension assembly (see Traction Unit Operator's Manual).

3. Install grass basket.

4. Connect the cutting unit power disconnect couplers.

Cutting Unit Suspension Assembly


19
16
85 to 115 in-lb
(9.6 to 12.9 N-m)
17
85 to 115 in-lb
(9.6 to 12.9 N-m)
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4
12
1
55 to 60 ft-lb
(75 to 81 N-m)
RIGHT
10
FRONT
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Figure 19

1. Suspension assembly (3 used)	**8. Lift cylinder**	**15. RH spring retainer (3 used)**
2. Flange screw (3 per suspension)	**9. RH stabilizer spring (3 used)**	**16. Socket head screw (6 used)**
3. Basket	**10. LH stabilizer spring (3 used)**	**17. Cable bracket**
4. Clevis pin (3 used)	**11. Spacer (6 used)**	**18. Cable bracket**
5. Cotter pin (3 used)	**12. Cap screw (6 used)**	**19. Washer head screw (4 used)**
6. Washer (3 used)	**13. Flange nut (6 used)**	**20. Cable bracket**
7. LH spring retainer (3 used)	**14. Flange head screw (6 used)**	**21. Cable bracket (2 used)**

NOTE: Three (3) identical cutting unit suspension assemblies are used on Greensmaster TriFlex Hybrid machines. The cutting unit attaches to the crossarm assembly which is attached to the front of the cutting unit suspension assembly. The crossarm assembly can be serviced with the suspension assembly attached to the machine (see Cutting Unit Suspension Crossarm Assembly in this section).

Removal (Fig. 19)

1. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Remove grass basket and cutting unit from suspension assembly (see Traction Unit Operator's Manual).

4. If front suspension assembly is to be removed, remove front wheel (see Wheel Removal in this section). This will allow easier access to flange head screws that secure suspension assembly to frame.

5. Loosen bulkhead nut that secures reel motor electrical cable to bracket on suspension assembly. Separate cable from bracket.

6. Position and support reel motor with attached electrical cable away from suspension assembly.

CAUTION

Support suspension assembly when removing it to prevent it from falling and causing personal injury. Suspension assembly weighs approximately 65 pounds (30 kg).

7. Support suspension assembly to prevent it from shifting or falling.

8. Remove three (3) flange head screws (item 2) that secure suspension assembly to machine frame. Remove suspension assembly from machine.

Installation (Fig. 19)

1. Make sure that all suspension components are correctly assembled.

2. Position suspension assembly to frame. Align mounting holes and secure suspension with three (3) flange head screws (item 2). Torques screws from **55 to 60 ft-lb (75 to 81 N-m)**.

3. Install front wheel if it was removed from machine (see Wheel Installation in this section).

4. Position reel motor with attached electrical cable to suspension assembly. Insert reel motor shaft into storage location on front of suspension assembly.

5. Install cutting unit to suspension assembly and secure reel motor to cutting unit. (see Traction Unit Operator's Manual).

6. Position electrical cable fitting into bracket on suspension assembly. Secure cable with bulkhead nut.

7. Install grass basket to suspension assembly.

8. Connect the cutting unit power disconnect couplers.

Cutting Unit Suspension Service

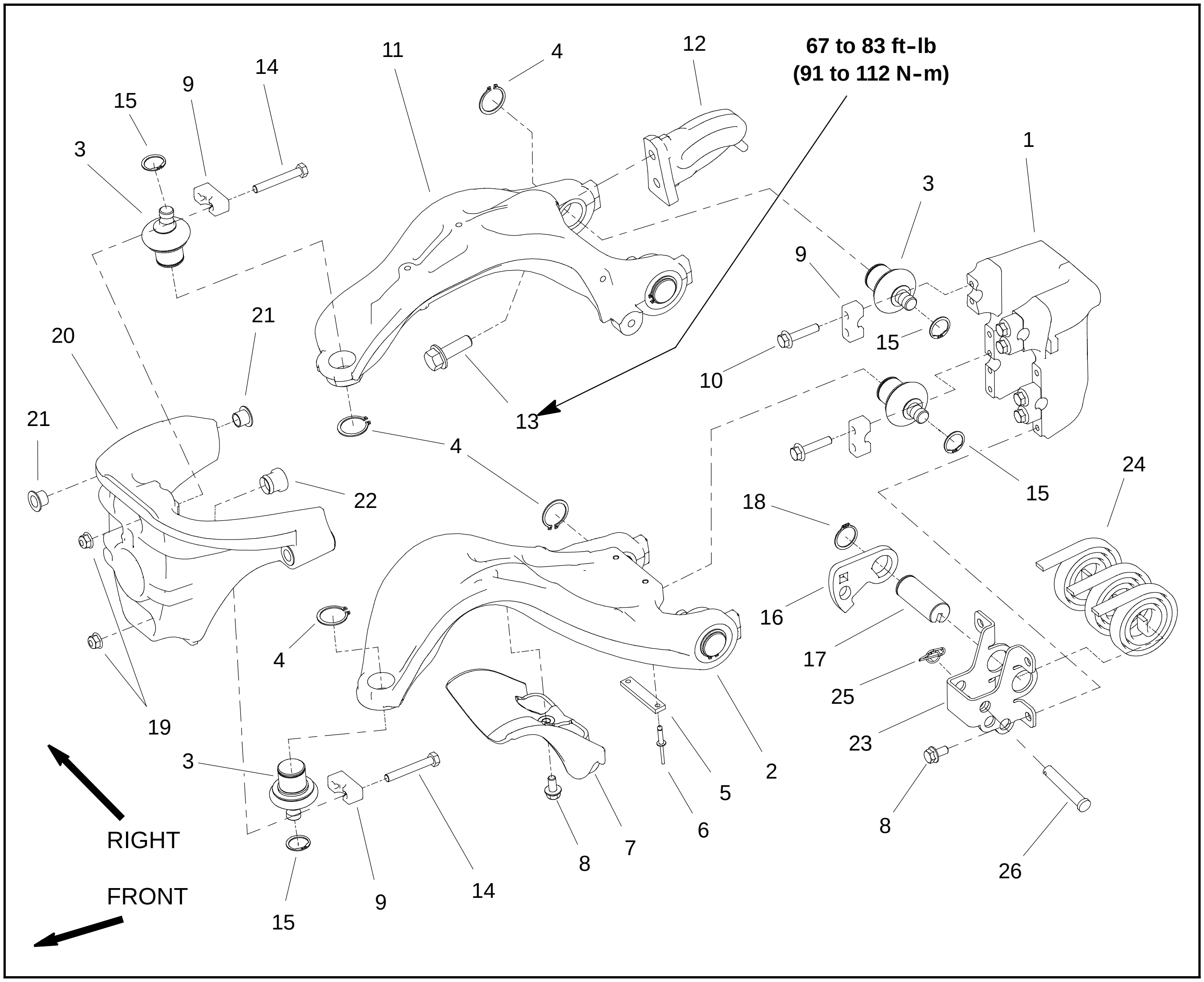
67 to 83 ft-lb
(91 to 112 N-m)
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Figure 20

1. **Pivot mount**
2. **Lower A-arm**
3. **Ball joint (6 used)**
4. **Retaining ring (6 used)**
5. **Striker plate**
6. **Pop rivet (2 used)**
7. **Steering stop**
8. **Flange head screw (5 used)**
9. **Clamp (6 used)**
10. **Flange head screw (8 used)**
11. **Upper A-arm**
12. **Lift plate**
13. **Flange head screw (2 used)**
14. **Cap screw (4 used)**
15. **Retaining ring (6 used)**
16. **Counterbalance tensioner arm**
17. **Pin**
18. **Retaining ring**
19. **Flange nut (4 used)**
20. **Steering head**
21. **Flange bushing (4 used)**
22. **Grommet**
23. **Counterbalance mount**
24. **Counterbalance spring (3 used)**
25. **Cotter pin**
26. **Clevis pin**

NOTE: Three (3) identical cutting unit suspension assemblies are used on Greensmaster TriFlex Hybrid machines. The cutting unit attaches to the crossarm assembly which is attached to the front of the cutting unit suspension assembly. See Cutting Unit Suspension Crossarm Assembly in this section for information regarding service of the crossarm assembly.

Disassembly (Fig. 20)

1. If cutting unit suspension is attached to machine:

   A. Park machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.

   B. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

2. Remove tension from suspension counterbalance assembly:

CAUTION

Be careful when removing tension from the suspension counterbalance system. The counterbalance spring is under heavy load and may cause personal injury.

   A. Remove cotter pin from clevis pin that secures counterbalance tensioner arm.

   B. Use 3/8” drive breaker bar in tensioner arm square drive hole to hold tensioner arm in place so that clevis pin can be removed.

   C. Remove clevis pin and allow counterbalance springs to relax.

3. Disassemble suspension assembly as required using Figure 20 as a guide.

NOTE: Medium strength Loctite #609 retaining compound is applied to ball joint housing during assembly. Localized heat around the ball joint housing will allow easier ball joint removal from A–arm.

Assembly (Fig. 20)

1. Install all removed suspension assembly components using Figure 20 as a guide.

   A. If any ball joint (item 3) was removed from A–arm, clean ball joint housing and A–arm bore with Loctite cleaning solvent (or equivalent) and allow to dry. Apply Loctite #609 retaining compound (or equivalent) to ball joint housing before inserting ball joint into A–arm.

   B. If any clamp (item 9) was removed, make sure that raised boss in clamp bore is positioned in groove of ball joint stud before securing clamp.

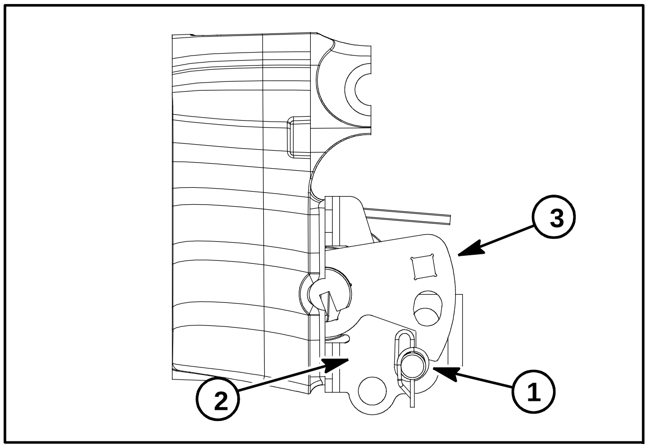

Figure 21

1. **Clevis pin**
2. **Counterbalance mount**
3. **Tensioner arm**

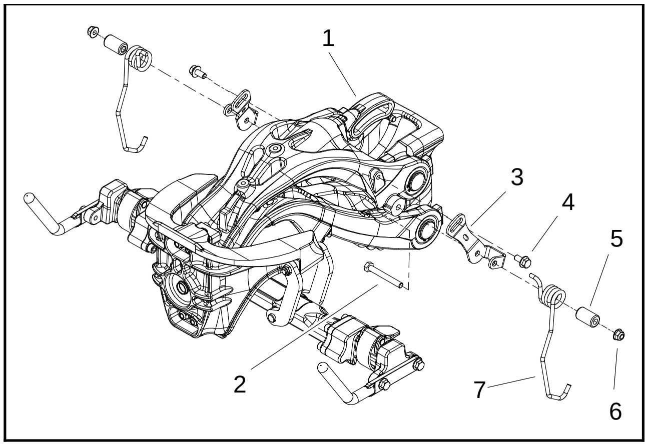

Figure 22

1. **Suspension assembly**
2. **Cap screw**
3. **Spring retainer**
4. **Flange head screw**
5. **Spacer**
6. **Flange nut**
7. **Stabilizer spring**

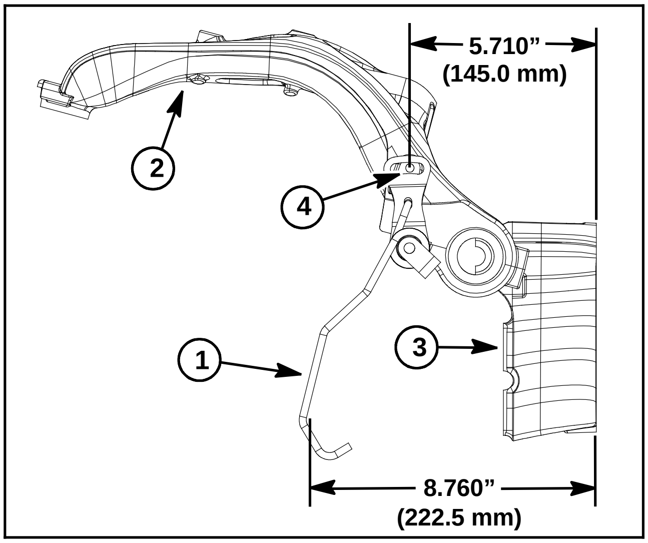

Figure 23

1. **Stabilizer spring**
2. **Upper a–arm**
3. **Pivot mount**
4. **Spring hole**

C. If lift plate (item 12) was removed from A–arm, secure lift plate with two (2) flange head screws (item 13). Torque screws from **67 to 83 ft–lb (91 to 112 N–m)**.

CAUTION

Be careful when assembling the suspension counterbalance system. The counterbalance spring is under heavy load and may cause personal injury.

D. If clevis pin (item 26) was removed from counterbalance mount (item 23), install clevis pin into middle holes in counterbalance mount and below tensioner arm (item 16). Tensioner arm can be rotated with breaker bar or ratchet wrench (3/8” square drive) to align holes. Figure 21 shows correct location of clevis pin.

E. If stabilizer springs were removed from suspension assembly, move and support suspension assembly so that upper a–arm has stabilizer spring attachment hole positioned **5.710” (145.0 mm)** from rear of pivot mount. Then, adjust location of spring so the center of the spring end is **8.760” (222.5 mm)** from rear of pivot mount. Figure 23 shows dimensions for correct stabilizer spring adjustment.

2. Connect the cutting unit power disconnect couplers.

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Frame Assembly

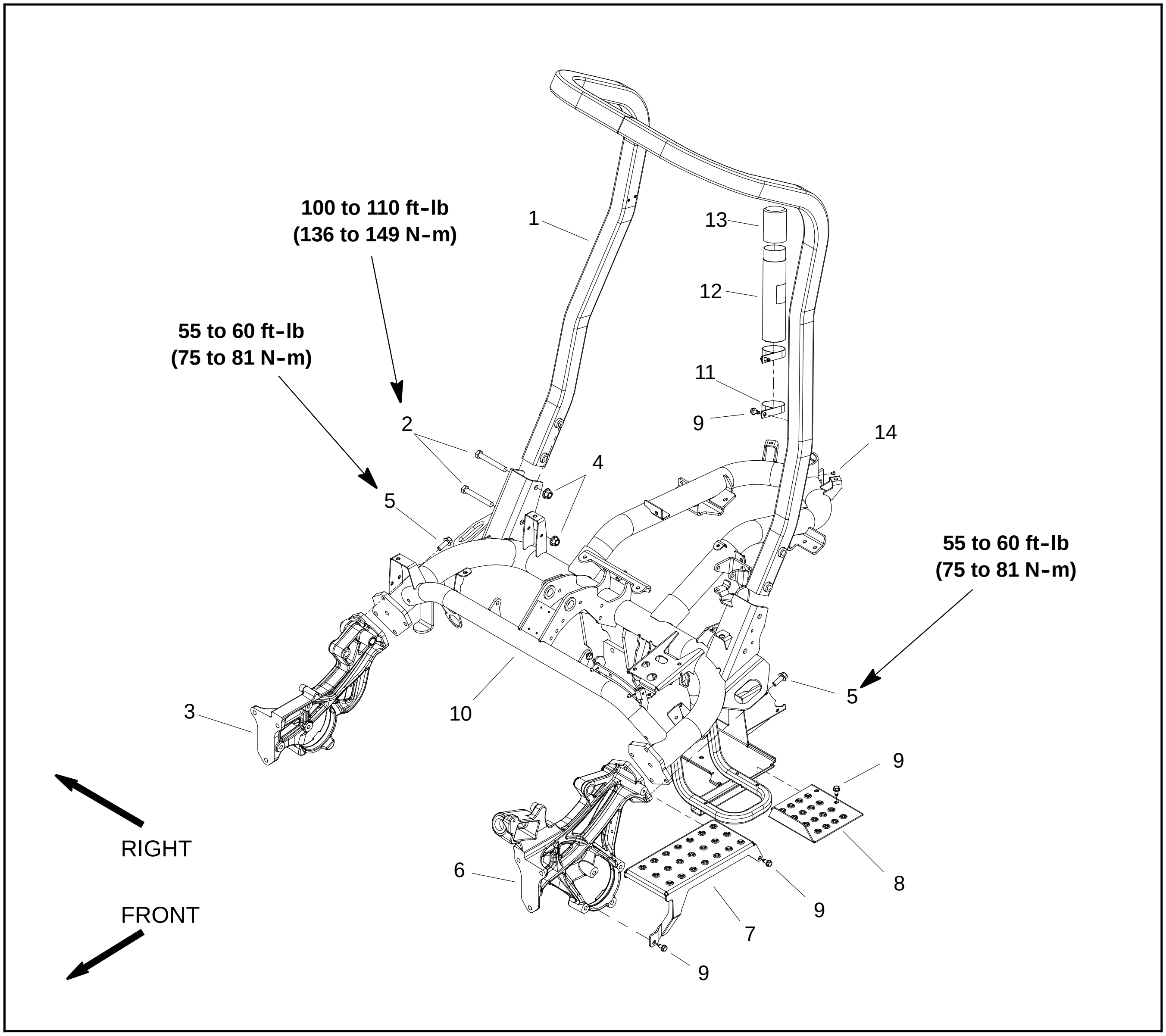
100 to 110 ft-lb
(136 to 149 N-m)
55 to 60 ft-lb
(75 to 81 N-m)
55 to 60 ft-lb
(75 to 81 N-m)
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Figure 24

1. **ROPS assembly**
2. **Cap screw (4 used)**
3. **RH side casting**
4. **Lock nut (4 used)**
5. **Flange head screw (8 used)**
6. **LH side casting**
7. **Step**
8. **Step plate**
9. **Washer head screw (9 used)**
10. **Frame assembly**
11. **R-clamp (2 used)**
12. **Manual tube**
13. **Cap**
14. **Plug**

The Greensmaster TriFlex Hybrid frame assembly is illustrated in Figure 24. If the fasteners used to secure the front castings or ROPS assembly are loosened or removed, refer to Figure 24 for fastener tightening torque recommendations.

Chapter 8

DPA Cutting Units

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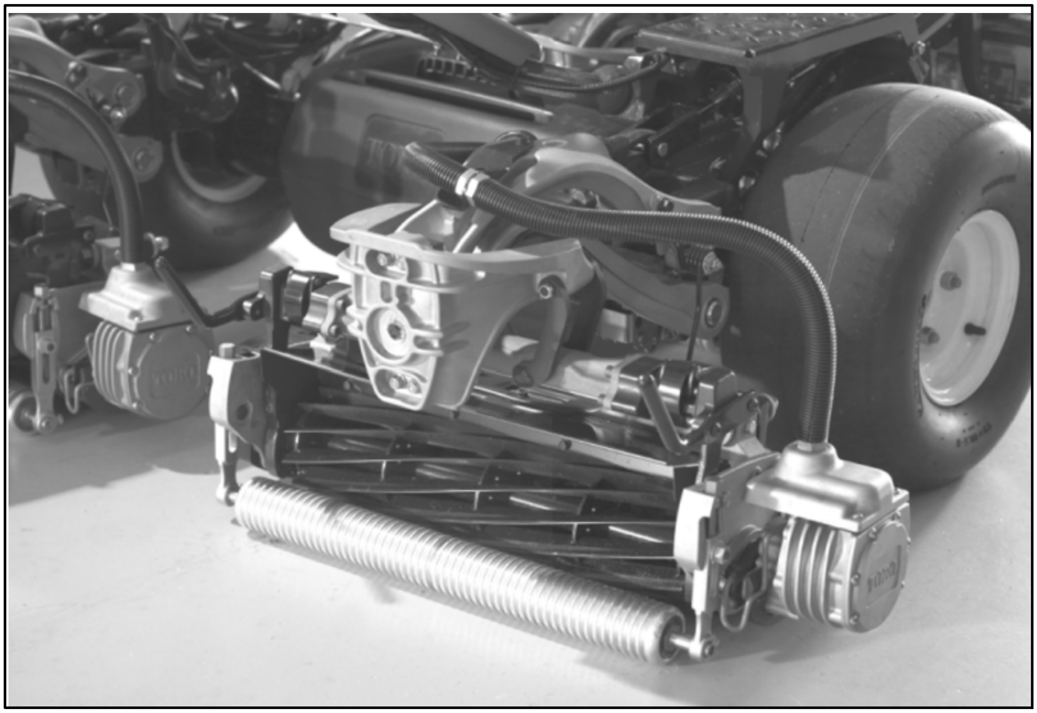

Figure 1

Frame Construction: Precision machined die cast aluminum cross member with two (2) bolt-on cast aluminum side plates.

Reel Construction: Reels are 21 inches (53.3 cm) in length and 5 inch (12.7 cm) in diameter. High strength, low alloy steel blades are thru hardened and impact resistant. Reels are available in 8, 11 and 14 blade configurations.

Reel Bearings: Two (2) sealed stainless steel, deep groove ball bearings support the reel shaft with inboard seal for protection.

Reel Drive: The reel weldment shaft is a 1.350 inch (34.3 mm) diameter tube with a drive insert threaded into the left end. The reel drive insert has an internal eight (8) tooth spline.

Height-of-Cut (HOC): Cutting height is adjusted on the front roller by two (2) vertical screws. Effective HOC may vary depending on turf conditions, type of bedknife, roller type and installed attachments.

Bedknife: Replaceable, single edged, high carbon steel bedknife is fastened to a machined cast iron bedbar with thirteen (13) screws. Optional bedknives are available.

Bedknife Adjustment: Dual screw adjustment to the reel; detents corresponding to 0.0007 inch (0.018 mm) bedknife movement for each indexed position.

Front and Rear Rollers: Greaseless through-shaft front and rear rollers are used with the TriFlex Hybrid DPA cutting units. All greens rollers use the same heavy duty ball bearing and seal package.

Counterbalance Weight: A cast iron weight mounted opposite to the electric reel motor balances the cutting unit.

Cutting Unit Weight:

21” Reel, 8 Blade	**71 lb (32 kg)**
21” Reel, 11 Blade	**74 lb (34 kg)**
21” Reel, 14 Blade	**77 lb (35 kg)**

Options: Refer to Cutting Unit Operator’s Manual for available options for your Greensmaster DPA cutting unit.

General Information

Cutting Unit Operator's Manual

The Cutting Unit Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for the DPA cutting units on your Greensmaster TriFlex Hybrid machine. Additionally, if optional kits have been installed on the cutting units (e.g. rear roller brush), the installation instructions for the kit includes set-up and operation information. Refer to those publications for additional information when servicing the cutting units.

Supporting Cutting Unit when Servicing

Whenever the cutting unit has to be tipped to expose the bedknife or cutting reel, support the rear of the cutting unit to make sure the lock nuts on the back of the bedbar adjusting screws are not resting on the work surface.

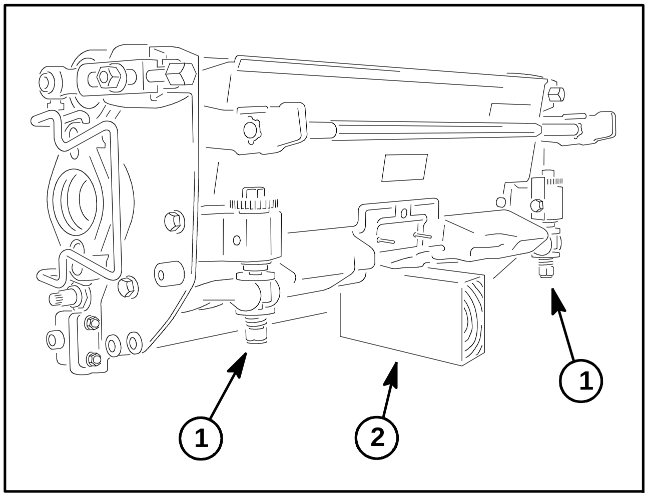

Figure 2

1. **Lock nut**
2. **Support**

Opening Electrical Circuit to Cutting Units

CAUTION

Before installing, removing or servicing the cutting units, separate the cutting unit power disconnect. This will prevent unexpected cutting unit operation.

Before installing, removing or working on the cutting units, disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (Fig. 3). The couplers are located at the base of the rollover bar on the left side of the traction unit. Connect the couplers together before operating the machine.

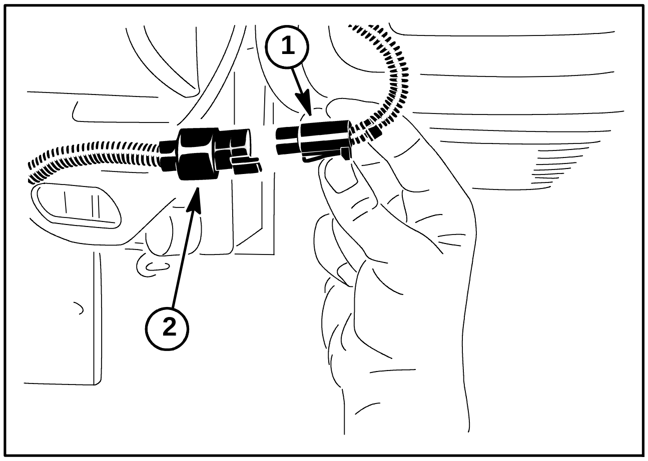

Figure 3

1. **Coupler**
2. **Stationary coupler**

Special Tools

Special tools for servicing Toro Commercial Products are available from your Toro Distributor. Some of these tools may have been supplied with your machine or are available as Toro parts.

Gauge Bar Assembly

Use gauge bar to verify height-of-cut adjustment.

Toro Part Number: **108-6715**

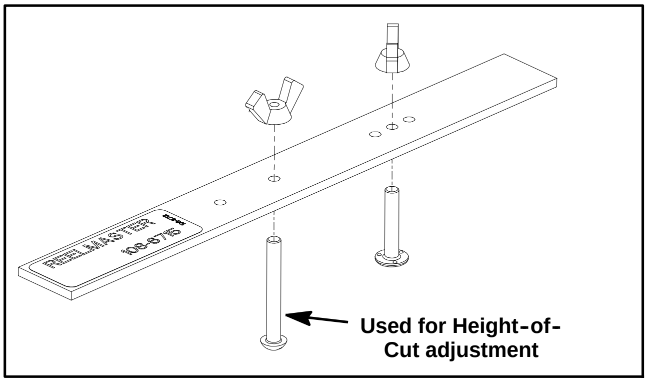

Figure 4

Bedknife Screw Tool

This screwdriver-type bit is made to fit Toro bedknife attaching screws. Use this bit with a torque wrench to secure the bedknife to the bedbar.

IMPORTANT: To prevent damage to the bedbar, DO NOT use an air or manual impact wrench with this tool.

Toro Part Number: **TOR510880**

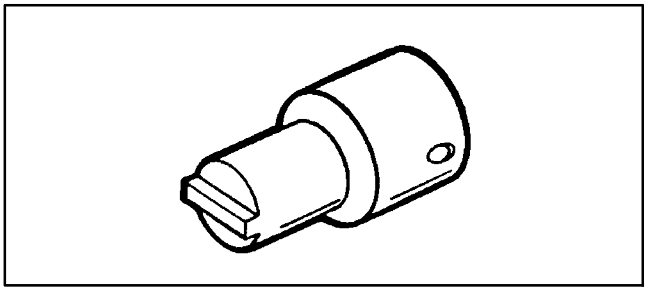

Figure 5

Long Handle Brush Assembly

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

Toro Part Number: **29-9100**

Components for the brush assembly are available individually as follows:

Brush	36-4310
Handle	29-9080
Handle cap	2410-18

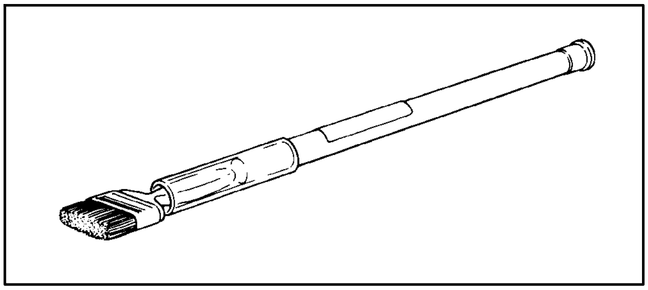

Figure 6

Roller Bearing Installation Tools

Washers and spacer used to install bearings and seals into front and rear rollers (Fig. 7).

Seal installation washer:	107–8133
Seal installation spacer:	107–3505
Bearing installation washer:	104–6126

As an alternative to using washers and spacers listed above, a special tool set is available that can be used for roller bearing and seal installation (Fig. 8).

Toro Part Number: **TOR4105**

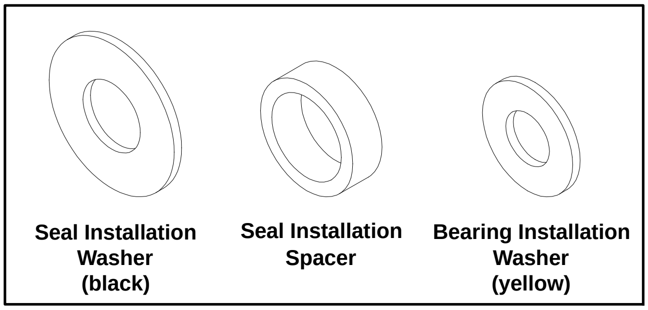
Seal Installation Washer (black)
Seal Installation Spacer
Bearing Installation Washer (yellow)

Figure 7

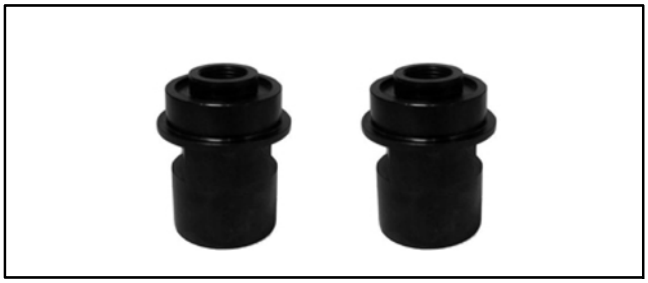

Figure 8

Diameter/Circumference Measuring Tape

Spring steel measuring tape for accurately measuring the circumference and outside diameter of cutting reel and other spherical components. Tape calibration is in fixed inch readings (no adjustments).

Toro Part Number: **TOR6023**

PI TAPE®
www.pitape.com

Figure 9

Turf Evaluator Tool

Many turf discrepancies are subtle and require closer examination. In these instances, the Turf Evaluator grass viewing tool is helpful. It can assist turf managers and service technicians in determining causes for poor reel mower performance and in comparing the effective height–of–cut of one mowed surface to another. This tool should be used with the Toro Guide to Evaluation Reel Mower Performance and Using the TurfEvaluator (Toro part no. 97931SL).

Toro Model Number: **04399**

Figure 10

Factors That Can Affect Cutting Performance

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, “sponginess” or attempting to cut off too much grass height may not always be overcome by adjusting the cutting unit. It is important to remember that the lower the height–of–cut, the more critical these factors are.

Refer to the Cutting Unit’s Operator’s Manual for detailed cutting unit adjustment procedures. For cutting unit repair information, refer to the Service and Repairs section of this chapter.

NOTE: For additional information regarding cutting unit troubleshooting, see **Aftercut Appearance Troubleshooting Aid (Toro part no. 00076SL)**.

Factor	Possible Problem/Correction
Tire pressure	Check tire pressure of all traction unit tires. Adjust tire pressure as necessary. See the Traction Unit Operator’s manual.
Governed engine speed	For best cutting performance and appearance, engine should be run at maximum governed speed during machine operation. Check maximum governed engine speed. Adjust engine to specifications if necessary. See Chapter 3 – Gasoline Engine or Chapter 4 – Diesel Engine.
Reel speed	All cutting reels must rotate at the same speed (within 100 rpm) All cutting units must have equal bedknife to reel and height–of–cut adjustments. Make sure that reel speed selection is correct (see Reel Speed Chart in Traction Unit Operator’s Manual).
Reel bearing condition	Check reel bearings for wear and replace if necessary. See Reel Assembly Service in the Service and Repairs section of this chapter.
Bedknife to reel adjustment	Check bedknife to reel contact daily. The bedknife must have light contact across the entire reel. No contact will dull the cutting edges. Excessive contact accelerates wear of both edges. Quality of cut is adversely affected by both conditions (see Bedknife to Reel Adjustment in the Cutting Unit Operator’s Manual).

Factor	Possible Problem/Correction
Reel and bedknife sharpness	A reel and/or bedknife that has rounded cutting edges or “rifling” (grooved or wavy appearance) **cannot** be corrected by tightening the bedknife to reel contact. Grind cutting reel to remove taper and/or rifling. Grind bedknife to sharpen and/or remove rifling. The most common cause of rifling is bedknife to reel contact that is too tight. Dull cutting edges must be corrected by grinding the bedknife and cutting reel (see Preparing Reel for Grinding in the Service and Repairs section of this chapter). **A new bedknife must be ground flat (within 0.002”) after installation to the bedbar. Backlapping may be required to properly mate the reel and bedknife after installation into the cutting unit.** **NOTE:** On cutting units equipped with optional bedknives, slightly dull cutting edges may be corrected by backlapping (see Backlapping in the Service and Repairs section of this chapter).
Rear roller adjustment	Adjust the rear roller brackets to correct position depending on the height-of-cut range desired. See Rear Roller Adjustment in the Cutting Unit Operator’s Manual.
Height-of-cut	“Effective” or actual height-of-cut depends on the cutting unit weight and turf conditions. Effective height-of-cut will be different from the bench set height-of-cut. See Height-of-Cut Adjustment in the Cutting Unit Operator’s Manual.
Proper bedknife selection for height-of-cut desired	If the bedknife is incorrect for effective height-of-cut, poor quality of cut will result. See Cutting Unit Operator’s Manual for bedknife options.
Stability of bedbar	Make sure bedbar pivot bolts are seated securely. Check condition of the bushings in the side plates. See Bedbar Removal and Installation in the Service and Repairs section of this chapter.
Number of reel blades	Use correct number of reel blades for clip frequency and optimum height-of-cut range.

Factor	Possible Problem/Correction
Roller condition and roller type	Make sure rollers rotate freely. Repair roller bearings as necessary. See Roller Service in the Service and Repairs section of this chapter. Refer to Cutting Unit Operator’s Manual for roller options.
Cutting unit accessories	A variety of cutting unit accessories are available that can be used to enhance aftercut appearance. Refer to Operator’s Manual for a listing of available accessories.

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Characteristics

CAUTION

Never install or work on the cutting units or cutting unit suspension with the engine running. Always stop engine and remove key first. Also, disconnect the cutting unit power coupler to make sure that cutting unit motors can not be unexpectedly engaged.

The dual knob bedknife–to–reel adjustment system incorporated in this cutting unit simplifies the adjustment procedure needed to deliver optimum mowing performance. The precise adjustment possible with this design gives the necessary control to provide a continual self–sharpening action. This feature maintains sharp cutting edges, assures good quality of cut and greatly reduces the need for routine backlapping.

In addition, the rear roller positioning system allows for various height-of-cut ranges and aggressiveness of cut selections.

If a cutting unit is determined to be out of adjustment, complete the following procedures in the specified order to adjust the cutting unit properly.

1. Adjust the bedknife parallel to the reel.
2. Determine desired height–of–cut range and install rear roller mounting shim(s) accordingly.
3. Adjust the height–of–cut.

See Cutting Unit Operator’s Manual for cutting unit adjustment procedures for your Greensmaster TriFlex Hybrid machine.

Leveling Rear Roller

The precision machined components of the cutting unit frame keep the rear roller and cutting reel in alignment (parallel). If the side plates are disassembled or as the cutting reel wears, a limited amount of side plate adjustment is possible to make sure that the cutting unit is properly aligned.

1. Place the assembled cutting unit on a surface plate.

2. Make sure that bedknife is properly adjusted to cutting reel.

3. Using the surface plate, check if rear roller is level to cutting reel by using a 0.005" (0.13 mm) shim at each end of rear roller. If the shim will pass under the roller at one end but not the other, a frame adjustment should be made.

4. Loosen, but do not remove, the two (2) shoulder bolts that secure the side plate to the frame opposite the side that is not level (Fig. 11).

5. Adjust the position of the side plate to parallel the rear roller and cutting reel. Then, tighten the shoulder bolts to a torque from **210 to 240 in-lb (24 to 27 N-m)**.

6. After tightening the side plate, recheck the rear roller. If necessary, loosen and adjust second side plate.

7. After leveling rear roller, complete cutting unit set-up and adjustment sequence.

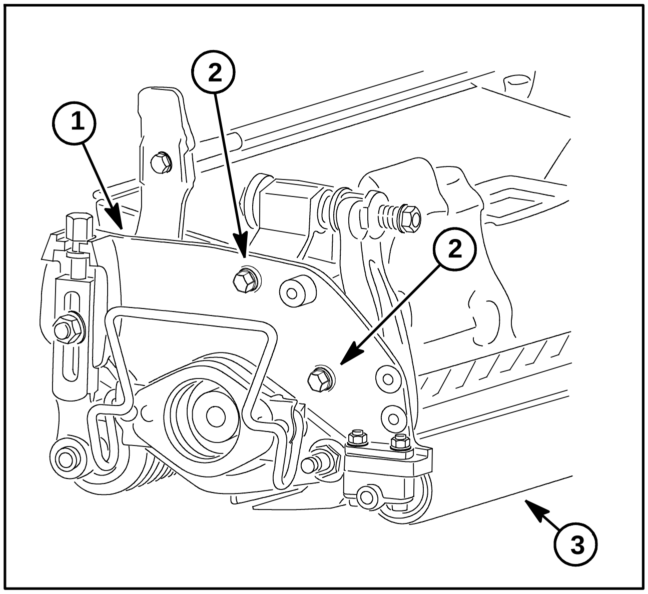

Figure 11

1. **Side plate**
2. **Shoulder bolt**
3. **Rear roller**

Backlapping

DANGER

TO AVOID PERSONAL INJURY OR DEATH:

- **Never place hands or feet in the reel area while the engine is running.**
- **When backlapping, run engine at idle speed only.**
- **While backlapping, the reels may stall and then restart.**
- **Do not attempt to restart reels by hand or foot.**
- **Do not adjust reels while the engine is running.**
- **If a reel stalls, stop engine before attempting to clear the reel.**
- **Reel motors are connected in series: rotating one motor causes rotation in other motors.**

NOTE: Additional instructions and procedures on backlapping are available in the **Toro General Service Training Book, Reel Mower Basics (part no. 09168SL)**.

1. Position the machine on a level surface, lower the cutting units, stop the engine and engage the parking brake. Place functional control lever in the neutral position.

2. Raise and support operator seat. Locate the reel speed control and backlap switch under the seat (Fig. 12). Rotate the reel speed control to position “1” and place the backlap switch in the backlap position.

3. Make initial reel to bedknife adjustments appropriate for backlapping on all cutting units which are to be backlapped.

4. Start engine and run at **idle speed**. Check that light on backlap switch is illuminated identifying that cutting reels are in the backlap mode.

5. Use joystick on the control console to engage the cutting units.

IMPORTANT: To prevent damage to the reel, do not rotate the backlap lever from the backlap position to the mow position while the engine is running.

6. Apply lapping compound with a long handle brush (see Special Tools in this chapter) (Fig. 13). Never use a short handle brush to apply lapping compound.

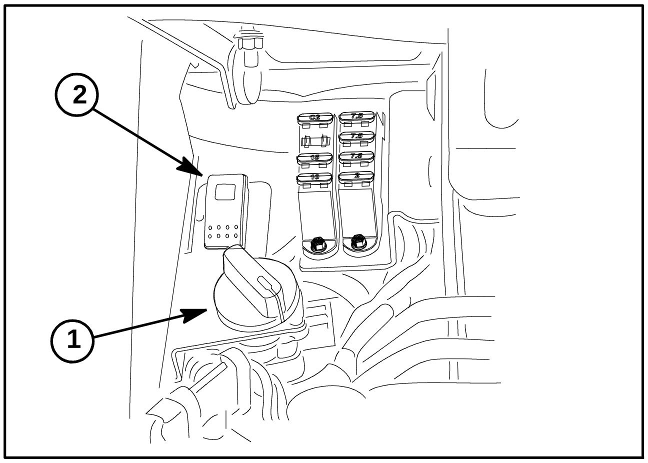

Figure 12

1. **Reel speed control**
2. **Backlap switch**

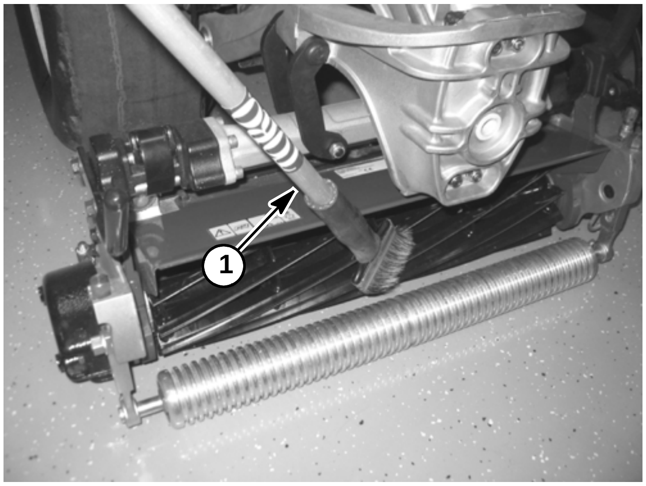

Figure 13

1. **Long Handle Brush**

DANGER

Reels may stall while backlapping. Do not attempt to restart reels by hand or touch reels while backlapping. Stop engine and turn reel speed control knob one position toward ”9.”

7. If reels stall or become erratic while backlapping, stop backlapping by disengaging the PTO with the joystick. Once the reels have stopped, move the reel speed control knob one position closer to “9.” Resume backlapping by engaging the PTO with the joystick.

8. To make an adjustment to the cutting units while backlapping, disengage the PTO with the joystick and turn the engine OFF. Wait for all machine movement to stop. After cutting unit adjustments have been completed, repeat steps 5 through 8.

9. When the backlapping operation is completed, stop the engine and remove the key from the ignition switch. Run a file across the front face of the bedknife. This will remove any burrs or rough edges that may have built up on the cutting edge.

10. Repeat procedure for all cutting units to be backlapped.

11. When backlap operation has been completed, return the backlap switch to the forward (mow) position, set reel speed control to desired speed and wash all lapping compound off cutting units. Lower operator seat.

12. Adjust cutting unit reel to bedknife as needed.

NOTE: If the backlap enable switch is not returned to the forward (mow) position after backlapping, the cutting units will not function properly.

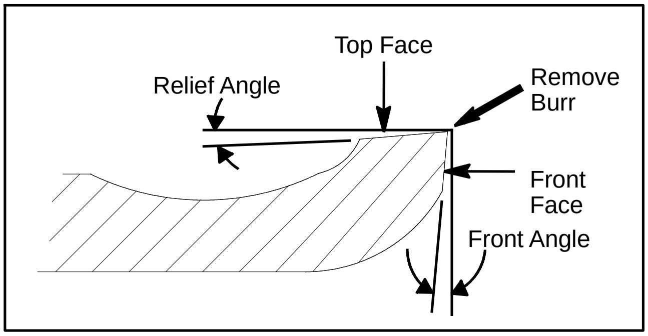

Figure 14

Bedbar Assembly

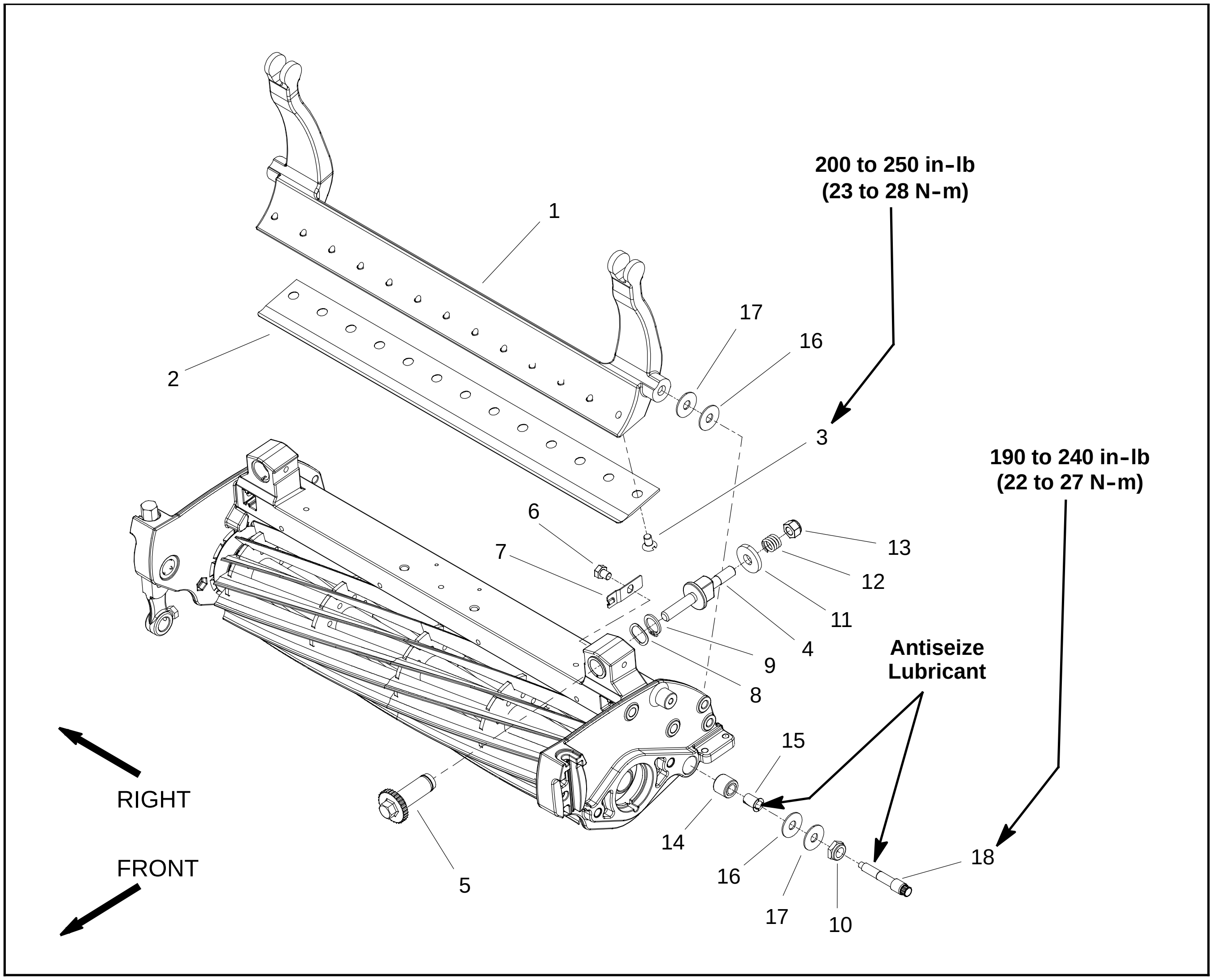

Figure 15

1. Bedbar	**7. Detent (2 used)**	**13. Lock nut (2 used)**
2. Bedknife	**8. Wave washer (2 used)**	**14. Rubber bushing (2 used)**
3. Screw (13 used)	**9. Retaining ring (2 used)**	**15. Nylon bushing (2 used)**
4. Bedbar adjuster screw (2 used)	**10. Lock nut (2 used)**	**16. Plastic washer (4 used)**
5. Bedbar adjuster shaft (2 used)	**11. Washer (2 used)**	**17. Metal washer (4 used)**
6. Cap screw (2 used)	**12. Compression spring (2 used)**	**18. Bedbar pivot bolt (2 used)**

Bedbar Removal (Fig. 15)

1. Position machine on a clean and level surface, lower cutting units, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove the cutting unit from the machine and place cutting unit on a flat work area.

3. Tip the cutting unit to expose the bedknife. Support the rear of the cutting unit (see Supporting Cutting Unit when Servicing in the General Information section of this chapter).

4. Loosen the lock nuts (item 13) on the end of each bedbar adjuster assembly until washer (item 11) is loose.

5. Loosen the lock nuts (item 10) on each bedbar pivot bolt (item 18).

6. Remove two (2) bedbar pivot bolts (item 18), four (4) metal washers (item 17) and four (4) plastic washers (item 16) from the cutting unit side plates.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the bedbar.

7. Remove bedbar assembly from cutting unit.

8. Inspect nylon bushings (item 15) and rubber bushings (item 14) in side plates for wear or damage. Remove bushings and replace if necessary.

Bedbar Installation (Fig. 15)

1. If rubber bushing was removed from either cutting unit side plate, apply grease to outside surface of new bushing and install into side plate. The bushing should be installed flush with the inside of the side plate (Fig. 16).

2. If removed, install the nylon bushings (item 15) with flange facing outward. Apply antiseize lubricant to inside of flange bushing.

3. Apply antiseize lubricant to the bedbar threads and the shoulder area of each bedbar pivot bolt (Fig. 16).

IMPORTANT: When installing washers (items 16 and 17), make sure that plastic washers are positioned on either side of the cutting unit sideplate (Fig. 16).

4. Slide one (1) metal washer (item 17) and then one (1) plastic washer (item 16) onto each bedbar pivot bolt.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the bedbar.

5. Position bedbar into cutting unit. Make sure that the top of each bedbar arm is between washer (item 11) and adjuster screw flange (item 4).

6. Position one (1) metal washer (item 17) and one (1) plastic washer (item 16) between bedbar and each cutting unit side plate (Fig. 16).

7. Install the bedbar pivot bolt assemblies. Make sure that plastic washers are not caught on the threads of the pivot bolts. Torque each bedbar pivot bolt from **190 to 240 in-lb (22 to 27 N-m)**.

8. Tighten both lock nuts (item 10) until outside washers do not have any endplay but still can be rotated. Do not over tighten the lock nuts as this can distort the side plates and affect reel bearing adjustment. When the lock nut is correctly tightened, there may be a gap at the inside washers.

9. Tighten the lock nut (item 13) on each bedbar adjuster assembly until the adjuster spring is fully compressed, then loosen lock nut 1/2 turn.

10. Adjust cutting unit (see Cutting Unit Operator's Manual).

11. Install cutting unit to machine.

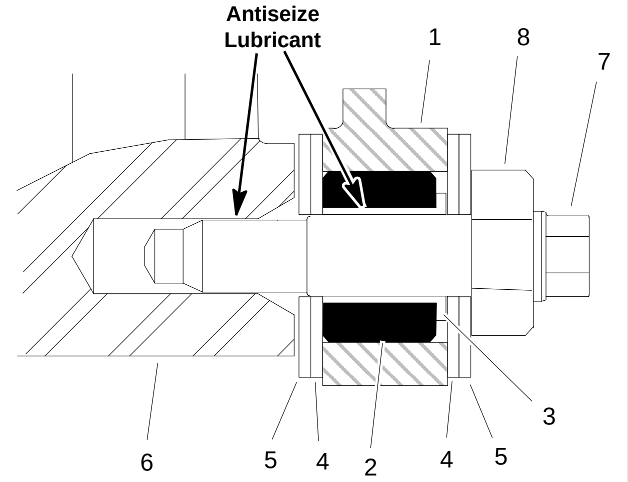

Figure 16

1. **Cutting unit sideplate**
2. **Rubber bushing**
3. **Nylon bushing**
4. **Plastic washer**
5. **Metal washer**
6. **Bedbar**
7. **Bedbar pivot bolt**
8. **Lock nut**

Bedbar Adjuster Service

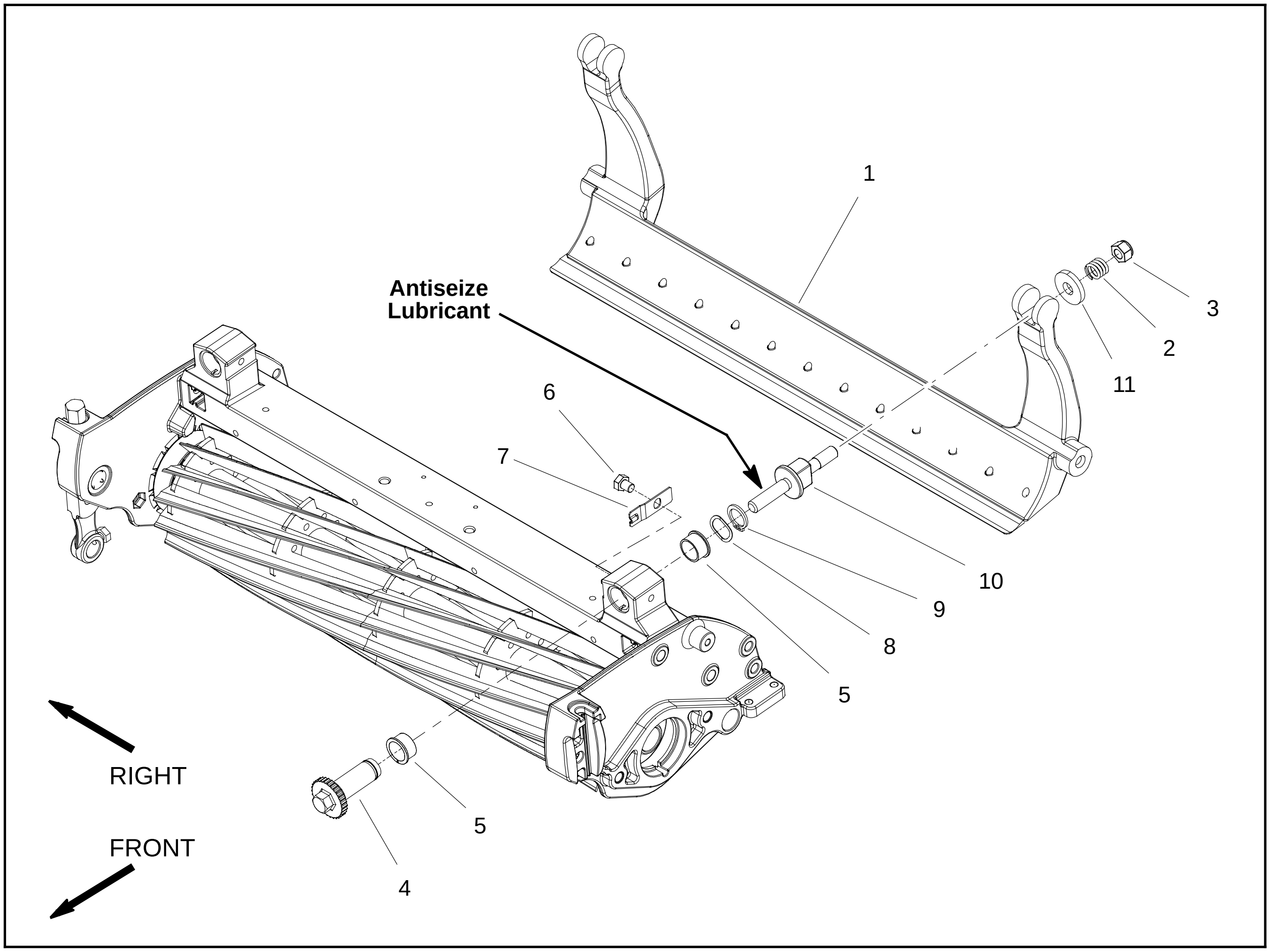
1
Antiseize Lubricant
3
2
11
6
7
10
9
8
5
RIGHT
FRONT
5
4

Figure 17

1. Bedbar assembly	**5. Flange bushing**	**9. Retaining ring**
2. Compression spring	**6. Cap screw**	**10. Bedbar adjuster screw**
3. Lock nut	**7. Detent**	**11. Washer**
4. Bedbar adjuster shaft	**8. Wave washer**	

Removal (Fig. 17)

1. Remove lock nut (item 3), compression spring (item 2) and washer (item 11) from bedbar adjuster screw.

2. Remove bedbar (see Bedbar Removal in this section).

NOTE: Bedbar adjuster shaft (item 4) has left-hand threads.

3. Unscrew bedbar adjuster shaft (item 4) from the bedbar adjuster screw.

4. Remove retaining ring (item 9) and wave washer (item 8) from adjuster shaft and remove adjuster shaft from cutting unit frame.

5. Inspect flange bushings (item 5) in cutting unit side plate and remove if necessary.

6. If detent (item 7) is damaged, remove it from cutting unit side plate by removing the cap screw (item 6).

Installation (Fig. 17)

1. If detent (item 7) was removed, secure detent to cutting unit side plate with cap screw.

2. If flange bushings (item 5) were removed, align key on bushing to slot in frame and install bushings.

3. Slide adjuster shaft (item 4) into flange bushings in cutting unit side plate. Secure adjuster shaft with wave washer (item 8) and retaining ring (item 9).

NOTE: Bedbar adjuster shaft (item 4) has left-hand threads.

4. Apply antiseize lubricant to threads of bedbar adjuster screw that fit into adjuster shaft. Thread bedbar adjuster screw (item 10) into adjuster shaft.

5. Install bedbar (see Bedbar Installation in this section).

6. Install washer (item 11), spring (item 2) and lock nut (item 3) onto adjuster screw. Tighten the lock nut on each bedbar adjuster assembly until the compression spring is fully compressed, then loosen lock nut 1/2 turn.

7. Adjust cutting unit (see Cutting Unit Operator’s Manual).

Bedknife Replacement and Grinding

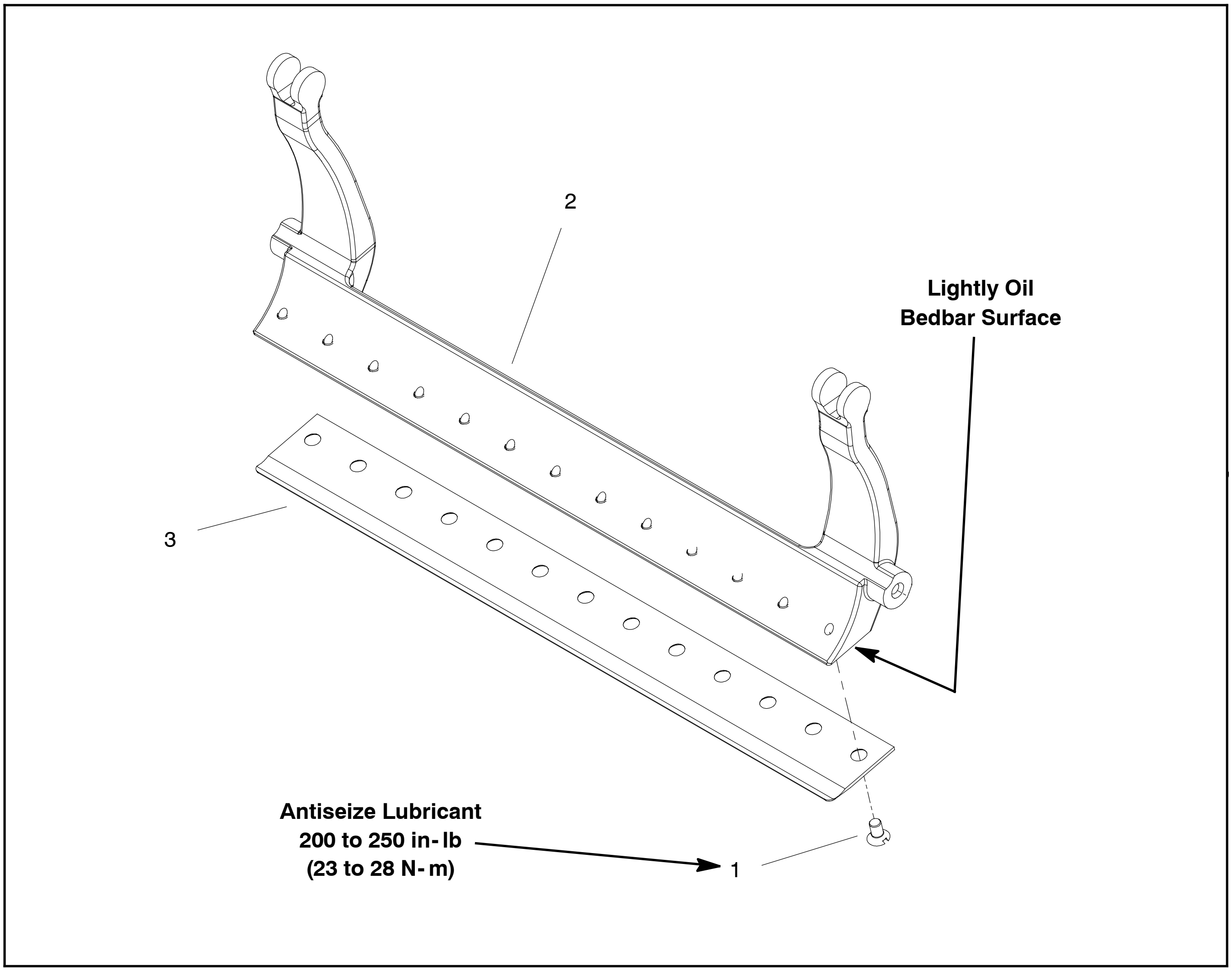

Figure 18

1. **Screw (13 used)**
2. **Bedbar**
3. **Bedknife**

Bedknife Removal (Fig. 18)

1. Remove bedbar from cutting unit (see Bedbar Assembly in this section).

2. Remove screws from bedbar using a socket wrench and bedknife screw tool (see Special Tools in this chapter). Discard removed screws. Remove bedknife from the bedbar.

Bedknife Installation (Fig. 18)

1. Use scraper to remove all rust, scale and corrosion from bedbar surface. Lightly oil bedbar surface before installing bedknife.

2. Make sure that screw threads in bedbar (5/16- 18UNC- 2A) are clean. If necessary, use tap to clean threads.

3. Apply antiseize lubricant to the threads of new screws. Take care to keep antiseize lubricant from taper on screw heads.

IMPORTANT: Do not use an impact wrench to tighten screws into the bedbar.

4. Use new screws to secure bedknife to bedbar. Install all screws but do not tighten. Use a torque wrench and bedknife screw tool to torque the two (2) end screws to **10 in- lb (1.1 N- m)** which will center the bedknife. Then, starting with center screw, torque all screws from **200 to 250 in- lb (23 to 28 N- m)**. Use a torquing pattern working from the center toward each end of the bedknife (Fig. 19).

5. After installing bedknife to bedbar, grind bedknife.

Bedknife Grinding

Since there can be variations in the mounting surface of the bedbar, a new bedknife will not be perfectly flat after it is installed to the bedbar. Because of this, it is necessary to grind a new bedknife after installing it to the bedbar. Follow the existing angle that was ground into the bedknife and grind only enough to make sure the top surface of the bedknife is true and perfectly flat (Fig. 20).

NOTE: When grinding the bedknife, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder. **Also, clean and dress grinding stone often during the grinding process.**

1. Use Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) and grinder manufacturer's instructions for bedknife grinding information.

2. After bedknife grinding is complete, install bedbar to cutting unit (see Bedbar Assembly in this section).

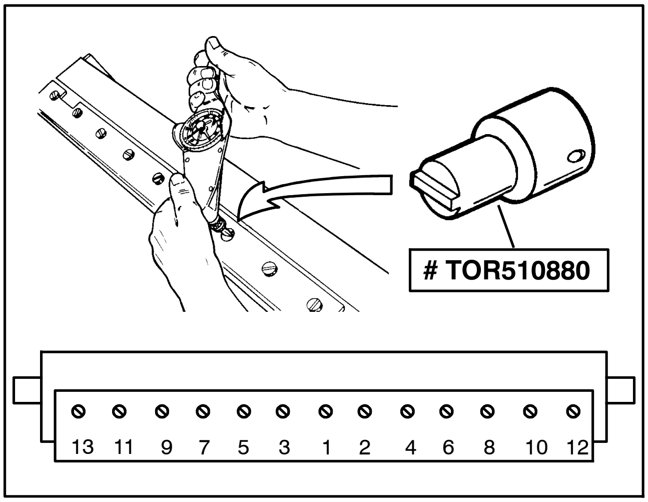
# TOR510880
13 11 9 7 5 3 1 2 4 6 8 10 12

Figure 19

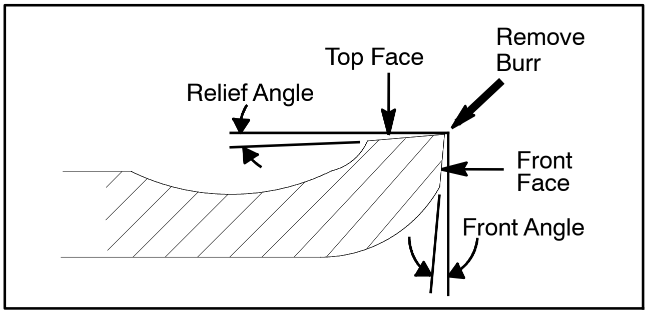
Remove Burr
Top Face
Relief Angle
Front Face
Front Angle

Figure 20

Bedknife Grinding Specifications (see Fig. 20)	
Standard bedknife relief angle	3^o (see Fig. 21)
Fairway bedknife relief angle	3^o (see Fig. 21)
Extended bedknife relief angle	7^o (see Fig. 21)
Front Angle (all bedknife types)	13^o
Front Angle Range	13^o to 17^o

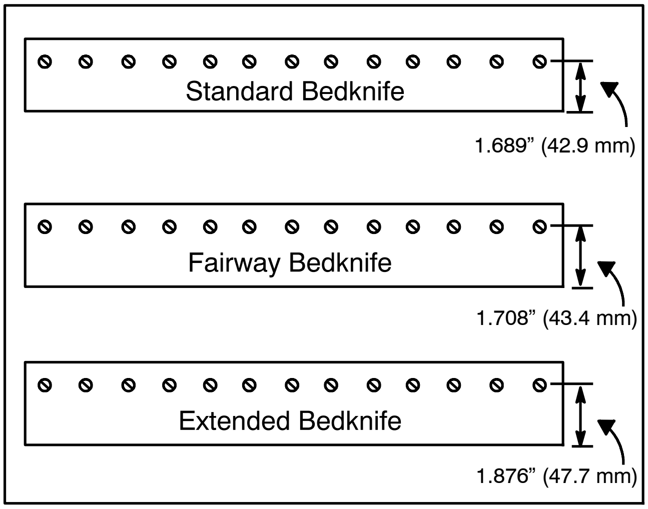
Standard Bedknife
1.689" (42.9 mm)
Fairway Bedknife
1.708" (43.4 mm)
Extended Bedknife
1.876" (47.7 mm)

Figure 21

Cutting Reel Assembly Removal and Installation

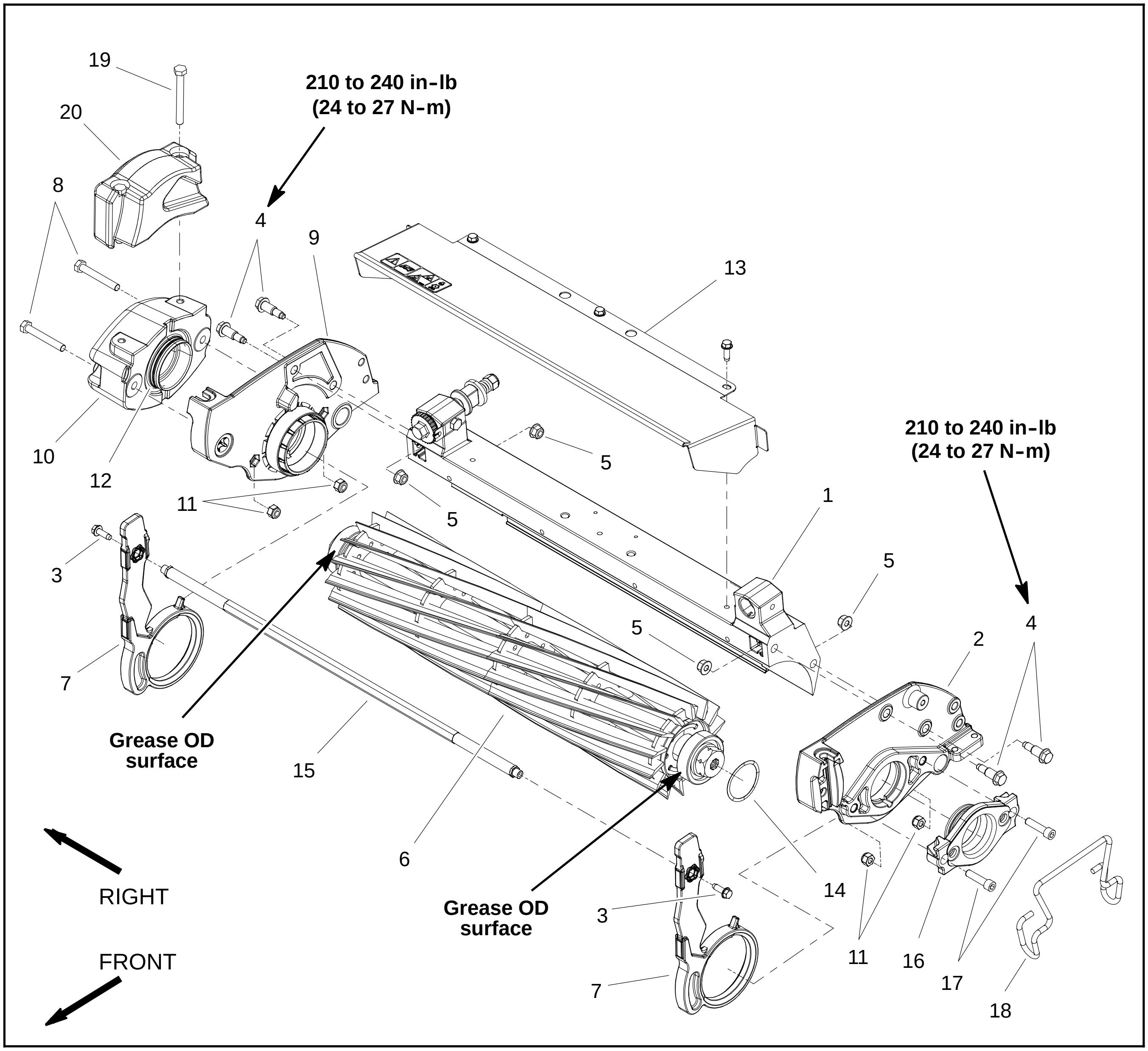
19
20
210 to 240 in-lb
(24 to 27 N-m)
8
4
9
13
10
12
11
5
3
1
5
210 to 240 in-lb
(24 to 27 N-m)
5
4
2
7
Grease OD
surface
15
6
RIGHT
Grease OD
surface
3
14
FRONT
7
11
16
17
18

Figure 22

1. **Crossmember**
2. **LH side plate**
3. **Washer head screw (2 used)**
4. **Shoulder bolt (2 used per side plate)**
5. **Flange nut (2 used per side plate)**
6. **Cutting reel assembly**
7. **Pitch arm (2 used)**
8. **Cap screw (2 used)**
9. **RH side plate**
10. **Weight**
11. **Hex nut (4 used)**
12. **O-ring**
13. **Grass shield**
14. **Flat wire spring**
15. **Crosslink**
16. **Reel motor adapter**
17. **Socket head screw (2 used)**
18. **Motor clamp**
19. **Cap screw (2 used)**
20. **Weight**

NOTE: This section provides the procedure for removing and installing the cutting reel assembly (cutting reel, flocked seals, reel bearings, bearing lock screw and reel nut) from the cutting unit. Refer to Reel Assembly Service later in this section for information on servicing the cutting reel assembly.

NOTE: Removal of the cutting reel requires removal of the LH side plate from the cutting unit crossmember. The RH side plate does not have to be removed from the frame when using the following procedure.

Cutting Reel Assembly Removal (Fig. 22)

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when removing the cutting reel.

1. Position machine on a clean and level surface, lower cutting units, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove the cutting unit from the machine and place cutting unit on a flat work area.

3. If cutting unit is equipped with an optional groomer or rear roller brush, remove drive components for those options from cutting unit. See Service and Repairs section of Chapter 9 – Groomer for information on groomer. See Rear Roller Brush in this section for information on rear roller brush.

4. Remove two (2) cap screws and nuts that secure weight (item 10) to the RH side plate. Remove weight assembly (items 10 and 20) from the cutting unit. Remove and discard O–ring from weight.

5. If bearings or seals are to be removed from cutting reel, put a block of wood between the cutting reel blades to prevent the reel from rotating. Loosen bearing lock nut (RH threads) and reel nut (LH threads) to allow easier removal after reel assembly is removed from cutting unit (Fig. 23).

6. Remove the bedbar pivot bolt and washers from the LH side plate. Note location of plastic and steel washers for assembly purposes (see Bedbar Removal in this section).

7. Loosen fasteners that secure front and rear rollers to LH side plate (see Front Roller Removal and Rear Roller Removal in this section).

8. Remove washer head screws (item 3) that secure crosslink (item 15) to pitch arms. Remove crosslink.

9. Support cutting reel to keep it from shifting or falling.

10. Remove shoulder bolts (item 4) and flange nuts (item 5) that secure the LH side plate to the cutting unit crossmember. Remove the LH side plate from the reel shaft, rollers, bedbar and cutting unit crossmember. Locate and remove flat wire spring (item 14). Remove pitch arm (item 7) from side plate.

11. Carefully slide the cutting reel assembly (with flocked seals, reel bearings, bearing lock screw and reel nut) from the RH side plate.

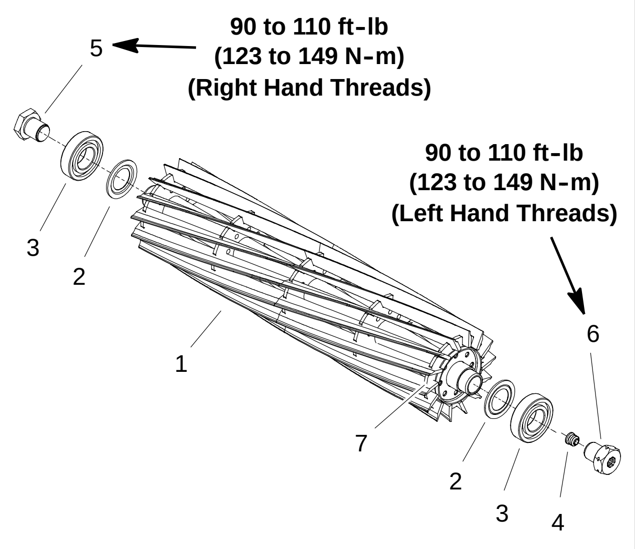

Figure 23

1. **Cutting reel**
2. **Flocked seal (2 used)**
3. **Bearing (2 used)**
4. **Plug**
5. **Bearing lock screw**
6. **Reel nut (LH threads)**
7. **Reel groove location**

Cutting Reel Assembly Installation (Fig. 22)

1. Thoroughly clean side plates and other cutting unit components. Inspect side plates and pitch arms for wear or damage and replace components if needed.

2. Make sure that flocked seals, reel bearings, bearing lock screw and reel nut are properly positioned on cutting reel (see Reel Assembly Service in this section). Apply thin coat of grease to outside of bearings on cutting reel to ease reel installation.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when installing the cutting reel.

3. Position the cutting unit on a flat work area. The rollers, bedbar and cutting unit crossmember should be attached to RH side plate. Make sure that pitch arm (item 7) is fitted to RH side plate.

4. Carefully slide the cutting reel assembly (with flocked seals, reel bearings, bearing lock screw and reel nut) into the RH side plate. Make sure that bearing is fully seated into side plate.

5. Place flat wire spring into bearing bore of LH side plate. Carefully slide the LH side plate with pitch arm onto the cutting reel assembly, front roller and rear roller. Make sure that side plate is fully seated onto bearing on reel shaft.

6. Install shoulder bolts (item 4) and flange nuts (item 5) to secure the LH side plates to the crossmember. Torque the shoulder bolts from **210 to 240 in–lb (24 to 27 N–m)**.

7. Position crosslink to pitch arms and secure with washer head screws (item 3).

8. If bearing lock nut (RH threads) and reel nut (LH threads) were loosened during cutting reel service, put a block of wood between the cutting reel blades to prevent the reel from rotating. Torque bearing lock nut (RH threads) and reel nut (LH threads) from **90 to 110 ft–lb (123 to 149 N–m)** (Fig. 23).

9. Thoroughly fill spline area of reel nut (left side of cutting reel) with grease.

10. Secure the bedbar assembly to LH side plate (see Bedbar Installation in this section). Make sure that plastic and steel washers are properly positioned.

11. Secure front and rear rollers to LH side plate (see Front Roller Installation and Rear Roller Installation in this section).

12. Adjust cutting unit (see Cutting Unit Operator's Manual).

NOTE: The parallel position of the rear roller to the cutting reel is controlled by the precision machined crossmember and side plates of the cutting unit. If necessary, the cutting unit side plates can be loosened and a slight adjustment can be made to parallel the rear roller with the cutting reel (see Leveling Rear Roller in the Set–Up and Adjustments section of this Chapter).

13. Install new O–ring (item 12) on weight. Secure weight assembly (items 10 and 20) to RH side plate with two (2) cap screws and nuts.

14. If cutting unit is equipped with optional groomer or rear roller brush, install components for those options to cutting unit. See Service and Repairs section of Chapter 8 – Groomer for information on groomer. See Rear Roller Brush in this section for information on rear roller brush.

15. Install cutting unit to the machine.

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Cutting Reel Assembly Service

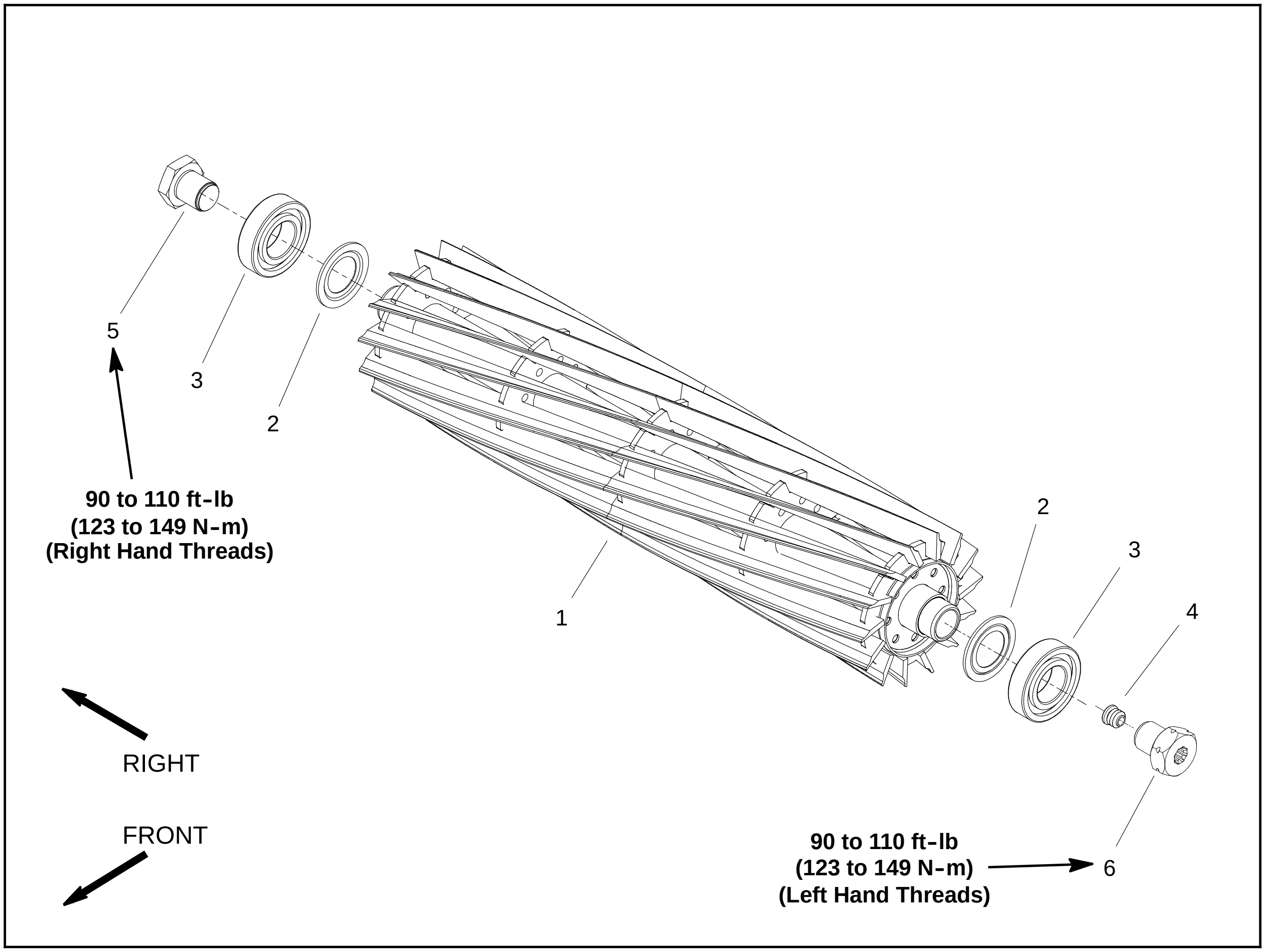
5
3
2
90 to 110 ft–lb
(123 to 149 N–m)
(Right Hand Threads)
2
3
4
1
RIGHT
FRONT
90 to 110 ft–lb
(123 to 149 N–m)
(Left Hand Threads)
6

Figure 24

1. Cutting reel	**3. Bearing (2 used)**	**5. Bearing lock screw (RH thread)**
2. Flocked seal (2 used)	**4. Plug**	**6. Reel nut (LH thread)**

Disassembly of Cutting Reel (Fig. 24)

1. Remove bearing lock screw (item 5) and reel nut (item 6) from cutting reel. Reel nut has LH threads and is in end of reel shaft identified with a groove that is just inside of reel spider (Fig. 25).

2. Slide bearings from reel shaft.

IMPORTANT: The reel shaft bearing journals are painted. Proper bearing fit on the reel shaft includes having the paint on the shaft to ensure correct bearing clearance. DO NOT remove paint from the reel shaft bearing journals when servicing the cutting reel.

3. Note orientation of flocked seals for assembly purposes. Remove seals from reel shaft.

Inspection of Cutting Reel (Fig. 24)

1. Inspect reel bearings to insure that they spin freely and have minimal axial play.

2. Inspect the reel shaft as follows. If reel damage is detected, replace reel.

    A. Check the reel shaft for bending and distortion by placing the shaft ends in V- blocks.

    B. Check the reel blades for bending or cracking.

    C. Check the service limit of the reel diameter (see Preparing a Reel for Grinding in this section).

    D. Check threads in ends of reel shaft.

3. Check the splines in the reel nut (item 6) for excessive wear or distortion. Replace reel nut if damage is evident.

Assembly of Cutting Reel (Fig. 24)

1. If bearings and/or flocked seals were removed from reel shaft, discard removed components and replace.

IMPORTANT: The flocked seal should be installed so the flocked side of the seal is toward the bearing location.

2. Slide flocked seals (flocked side orientated toward bearing location) and bearings fully onto reel shaft. Bearings and seals should bottom on reel shaft shoulder.

3. Install bearing lock screw (item 5) and reel nut (item 6) into reel shaft to secure bearings. Reel nut has LH threads and should be installed in end of reel shaft identified with a groove that is just inside of reel spider (Fig. 25).

NOTE: Installation torque for bearing lock screw and reel nut is from **90 to 110 ft- lb (123 to 149 N- m)**. It is easiest to torque these items after the cutting reel is installed in the cutting unit frame (see Reel Assembly Removal and Installation in this section).

4. Thoroughly fill spline area of reel nut (left side of cutting reel) with grease.

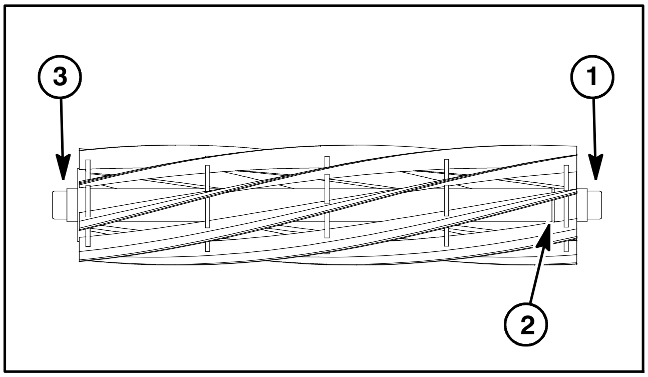

Figure 25

1. **LH threads**
2. **Groove**
3. **RH threads**

Preparing Reel for Grinding

Reel Grinding Specifications	
Reel Diameter (New)	5.06 in (128.5 mm)
Service Limit - Reel Diameter	4.50 in (114.3 mm)
Reel Shaft Diameter (OD)	1.375 in (34.9 mm)
Blade Relief Angle	30º
Blade Relief Angle Range	28º to 32º
Blade Land Width	0.040 in (1.0 mm)
Blade Land Width Range	0.030 to 0.050 in (0.8 to 1.2 mm)
Service Limit - Reel Diameter Taper	0.010 in (0.25 mm)

NOTE: Before grinding a cutting reel, make sure that all cutting unit components are in good condition. Depending on type of grinder used, faulty cutting unit components can affect grinding results.

NOTE: When grinding, be careful to not overheat the cutting reel blades. Remove small amounts of material with each pass of the grinder.

1. Follow reel grinder manufacturer's instructions to grind cutting reel to Toro specifications (see Reel Grinding Specifications chart to the right). Additional reel grinding information can be found in the Toro General Service Training Book, Reel Mower Basics (part no. 09168SL).

2. After completing the reel grinding process, adjust cutting unit (see Cutting Unit Operator's Manual).

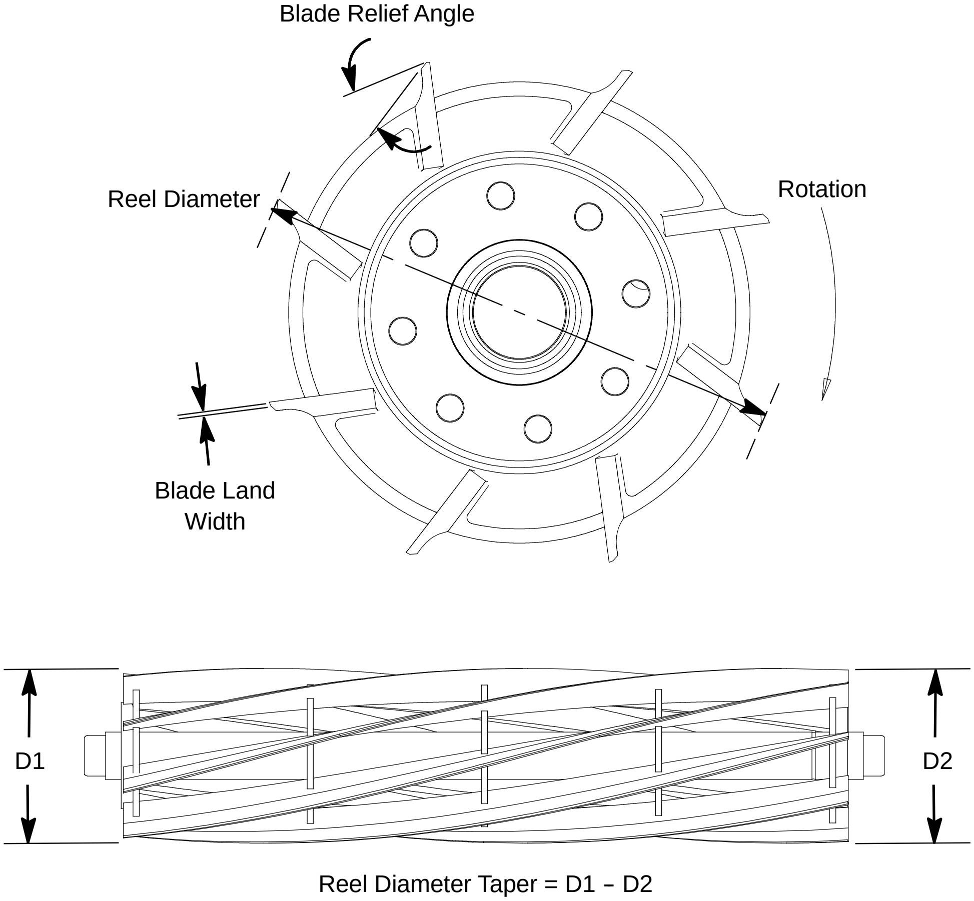

Figure 26

Reel Motor Adapter

Removal

1. Position machine on a clean and level surface, lower cutting units, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove the electric reel motor from the cutting unit (see Cutting Reel Motors in the Service and Repairs section of Chapter 6 – Electrical System). Move motor to storage location on front of cutting unit suspension assembly.

3. Remove reel motor adapter from cutting unit side plate using Fig. 27 as a guide.

4. Remove O–rings as necessary from motor adapter (Fig. 28).

Installation

1. If large O–ring was removed from flange of motor adapter, lubricate O–ring with grease. Small O–rings should be installed into motor adapter without lubrication. Make sure that O–rings are correctly positioned in grooves in adapter.

2. Install reel motor adapter to cutting unit side plate using Fig. 27 as a guide.

3. Secure electric reel motor to the cutting unit (see Cutting Reel Motors in the Service and Repairs section of Chapter 6 – Electrical System).

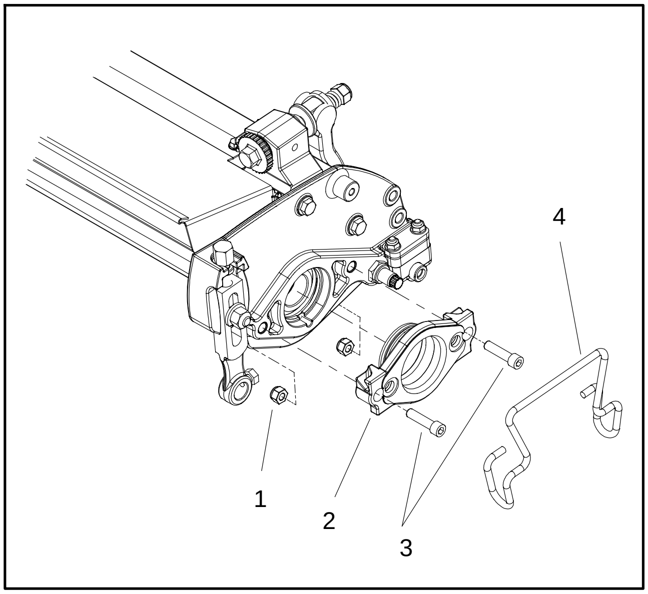

Figure 27

1. Hex nut	**3. Socket head screw**
2. Reel motor adapter	**4. Motor clamp**

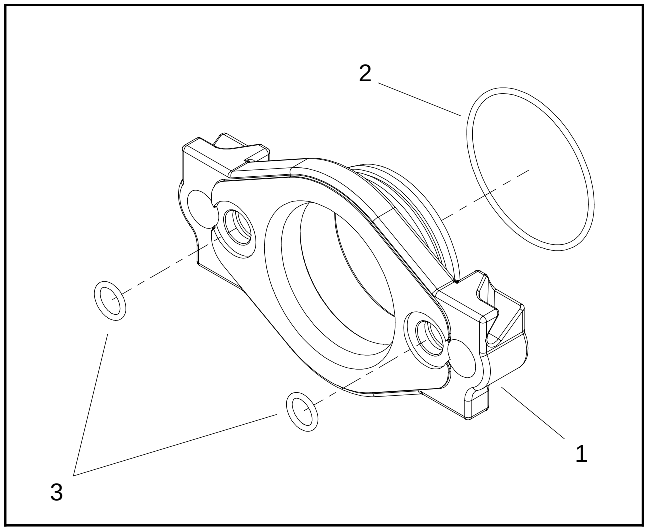

Figure 28

1. Adapter	**3. O–ring**
2. O–ring	

Front Roller

Removal (Fig. 29)

1. Position machine on a clean and level surface, lower cutting units, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove the cutting unit from the machine and place on a level working surface. Use appropriate support to raise front roller from work surface.

3. Loosen cap screw (item 1) that secures the front roller shaft to each front height-of-cut arm.

4. On one of the height-of-cut arms, remove HOC nut (item 7), HOC washer (item 6) and plow bolt (item 4) that secure HOC arm to the cutting unit side plate. Remove the HOC arm from the cutting unit.

5. Slide the front roller assembly from the remaining HOC arm on the cutting unit.

6. If necessary, remove the second HOC arm from the cutting unit.

Installation (Fig. 29)

1. Place cutting unit on a level working surface and use appropriate support to support front of cutting unit.

2. Inspect condition of HOC screws (item 5) in both HOC arms. If necessary, apply antiseize lubricant to threads of new HOC screw. Thread new HOC screw into HOC arm.

NOTE: When assembling HOC arms to side plates, make sure that ring on HOC screw fits into the notch on the side plate.

3. If both HOC arms were removed from cutting unit side plate, position one of the arms to side plate. Secure arm to side plate with plow bolt (item 4), HOC washer (item 6) and HOC nut (item 7). Tab on HOC washer should be positioned into HOC arm slot and orientated down toward the roller.

4. Slide front roller shaft into arm attached to the cutting unit. Slide second HOC arm onto the other end of roller shaft. Secure second arm to cutting unit side plate with plow bolt (item 4), HOC washer (item 6) and HOC nut (item 7).

5. Center front roller to the cutting reel and secure to HOC arms with cap screws (item 1).

6. Adjust cutting unit (see Cutting Unit Operator's Manual).

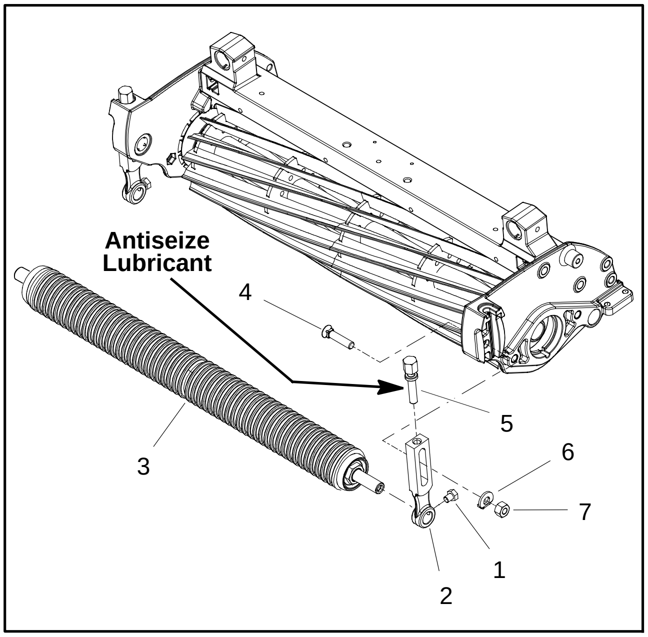

Figure 29

1. **Cap screw**
2. **HOC arm**
3. **Front roller assembly**
4. **Plow bolt**
5. **HOC screw**
6. **HOC washer**
7. **HOC nut**

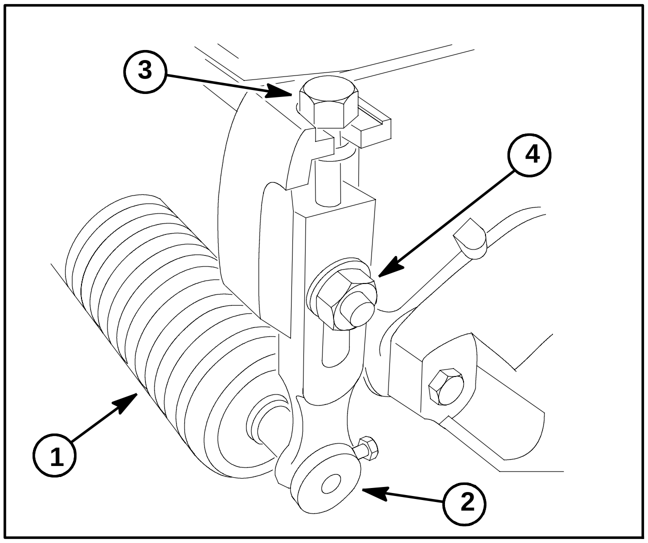

Figure 30

1. **Front roller assembly**
2. **HOC arm**
3. **HOC screw**
4. **HOC washer & nut**

Rear Roller

Removal (Fig. 31)

1. Position machine on a clean and level surface, lower cutting units, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove the cutting unit from the machine and place on a level working surface. Place support blocks under bedbar to raise rear roller from work surface.

3. Loosen two (2) flange nuts that secure the rear roller shaft to each rear roller bracket.

4. On one of the rear roller brackets:

NOTE: On cutting units equipped with optional High Height of Cut Kit, there will be additional roller shims installed between rear roller bracket and cutting unit side plate.

A. Note quantity and location of roller shims for assembly purposes.

B. Remove flange nuts and socket head screws that secure shaft retainer, roller height spacer and roller shims to the cutting unit side plate.

C. Remove the roller bracket and roller shims from the rear roller and cutting unit.

5. Slide the rear roller assembly from the remaining rear roller bracket on the cutting unit.

6. If necessary, remove the second rear roller bracket and roller shims from the cutting unit.

Installation (Fig. 31)

1. Place cutting unit on a level working surface.

NOTE: Refer to Cutting Unit Operator's Manual for number of roller shims required for various height of cut settings.

2. If both rear roller brackets were removed from cutting unit side plate, position brackets and roller shims to one of the side plates. Install two (2) carriage screws and flange nuts to retain bracket in position. Do not fully tighten flange nuts.

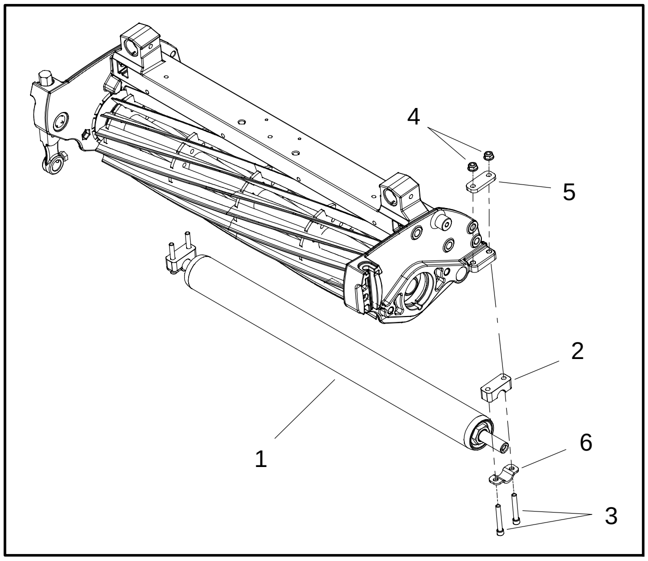

Figure 31

1. **Rear roller assembly**
2. **Roller height spacer**
3. **Socket head screw**
4. **Flange nut**
5. **Roller shim**
6. **Shaft retainer**

3. Slide rear roller shaft into the rear roller bracket attached to the cutting unit. Slide second rear roller bracket onto the other end of roller shaft. Secure second roller bracket and shims to cutting unit side plate with two (2) carriage screws and flange nuts. Do not fully tighten flange nuts.

4. Center rear roller to the cutting reel and secure in place by tightening four (4) flange nuts.

5. Adjust cutting unit (see Cutting Unit Operator's Manual).

Roller Service

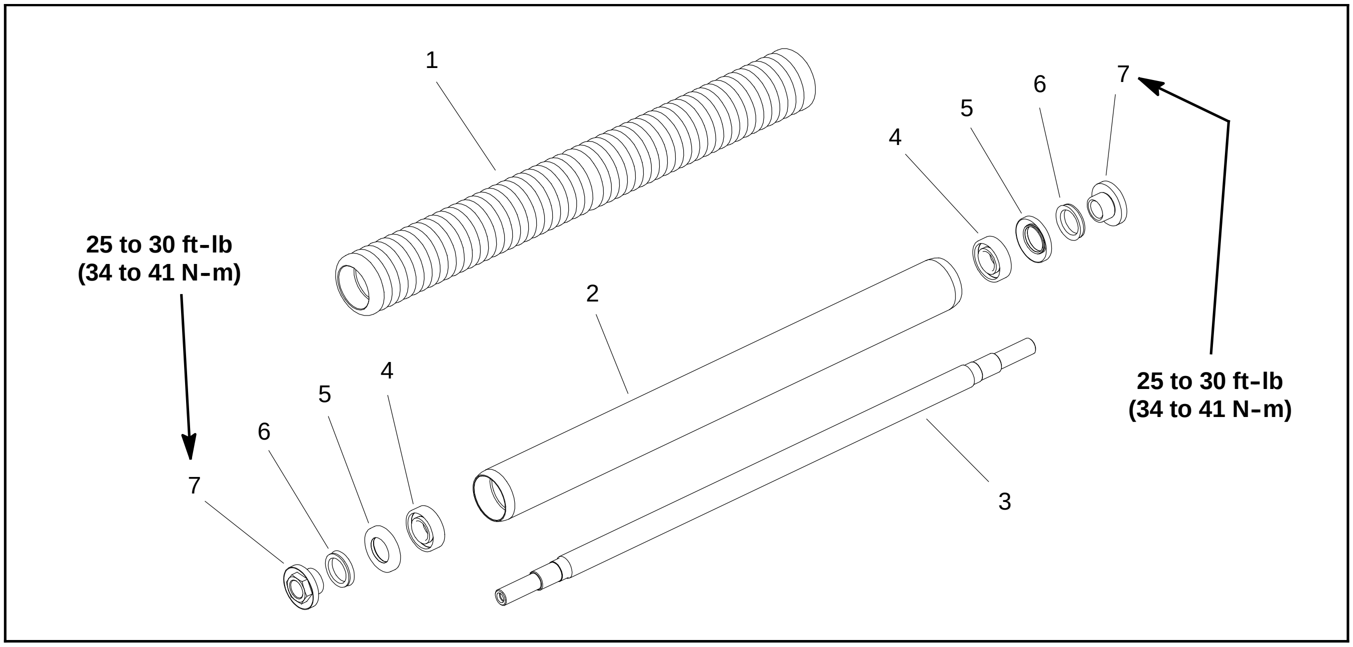

Figure 32

1. **Wiehle roller**
2. **Smooth roller**
3. **Roller shaft**
4. **Ball bearing**
5. **Seal**
6. **V-ring**
7. **Bearing lock nut**

Disassembly

1. To hold roller shaft for bearing lock nut removal, install a 3/8-24 UNF 2B screw into threaded end of roller shaft and secure screw in place with jam nut. While retaining shaft, remove bearing lock nut from each end of roller shaft.

2. Remove V-ring from each end of roller.

3. Carefully inspect seating surface and threads of bearing lock nuts. Replace lock nut if any damage is found.

4. Loosely secure roller assembly in bench vise and lightly tap one end of roller shaft until seal and bearing are removed from roller cavity. Remove second seal and bearing from roller cavity by tapping on shaft.

5. Clean bearing cavity in roller and remove any rust with crocus cloth.

Assembly

1. Place roller shaft into roller.

NOTE: If bearing lock nuts are being replaced, use original lock nuts for assembly purposes, if possible. This will preserve the patch lock feature in the new lock nuts. Use the new nuts only after new bearings and seals have been installed.

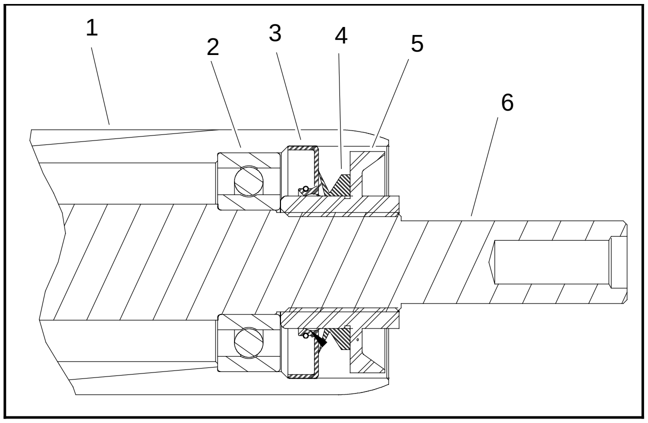

Figure 33

1. **Roller**
2. **Ball bearing**
3. **Seal**
4. **V-ring**
5. **Bearing lock nut**
6. **Roller shaft**

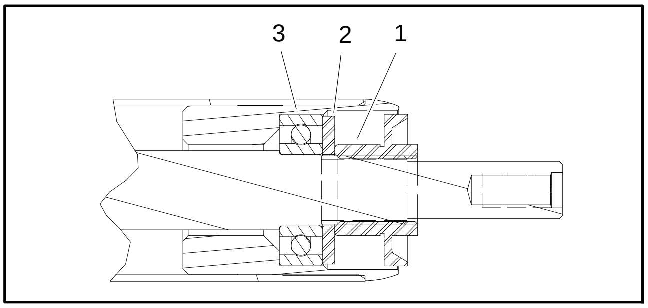

Figure 34

1. **Bearing lock nut**
2. **Black assembly washer**
3. **Bearing**

NOTE: Special tool TOR4105 (see Special Tools) can be used instead of washers and spacer when installing bearings and seals in roller.

2. Position a new bearing, black assembly washer (see Special Tools) and original lock nut onto each end of the roller shaft (Fig. 34).

3. Tighten nuts until the bearings are seated into each end of the roller.

4. Remove nut and black assembly washer from each end of the roller.

IMPORTANT: Failure to grease bearing lock nut before seal installation may result in seal damage.

5. Apply a coating of grease to the nut surface to prevent seal damage during seal installation (Fig. 35).

6. Carefully install seals onto bearing lock nuts. Pack the back of the seal 75 to 90% full with #2 grease (Fig. 35).

7. Install a nut with seal onto each end of the roller shaft. Tighten nuts until they bottom against bearings (Fig. 36). Remove nuts from roller shaft.

8. Position an assembly spacer and yellow assembly washer (see Special Tools) on each end of roller shaft (Fig. 37). Thread nut onto each end of shaft.

9. Tighten each nut until the yellow assembly washers bottom out against the roller housing. Remove nuts, assembly washers and assembly spacers from roller shaft.

10. Lubricate lips of installed seals with #2 grease.

11. Carefully slide a dry V–ring onto each bearing lock nut. The V–rings should be installed without any lubrication.

NOTE: If original bearing lock nut(s) are being used, apply Loctite #242 (or equivalent) to threads of lock nut(s).

12. Install bearing lock nut with V–ring onto each end of the roller shaft. Torque lock nuts from **25 to 30 ft–lb (34 to 41 N–m)**.

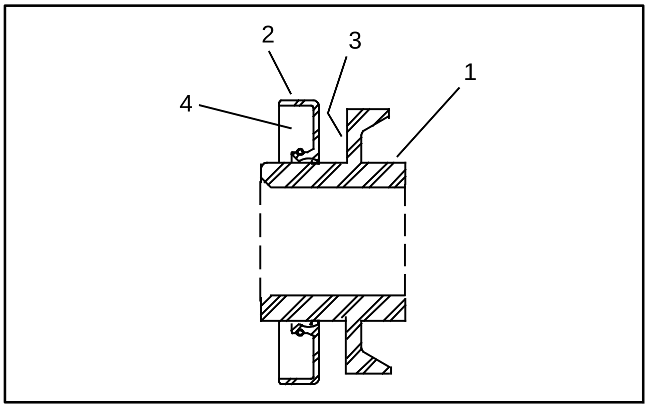

Figure 35

1. **Bearing lock nut**
2. **Seal**
3. **Grease nut surface**
4. **Pack with grease**

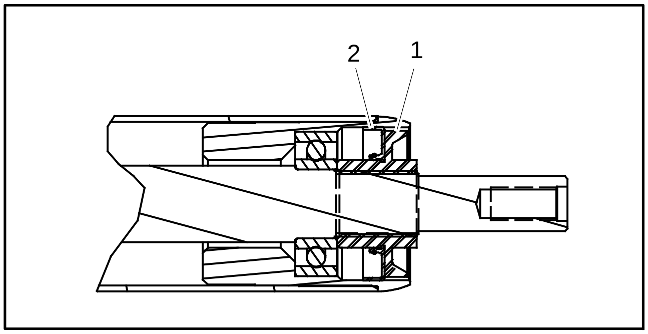

Figure 36

1. **Bearing lock nut**
2. **Seal**

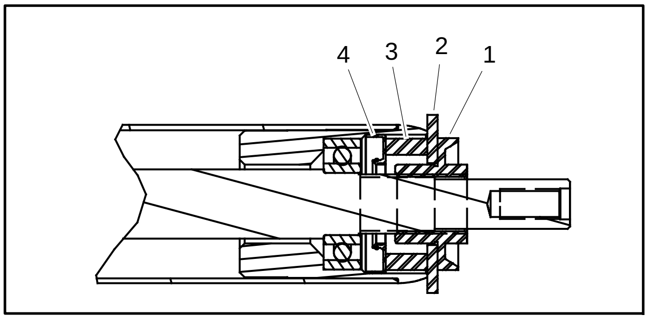

Figure 37

1. **Bearing lock nut**
2. **Yellow assembly washer**
3. **Assembly spacer**
4. **Seal**

Rear Roller Brush (Optional)

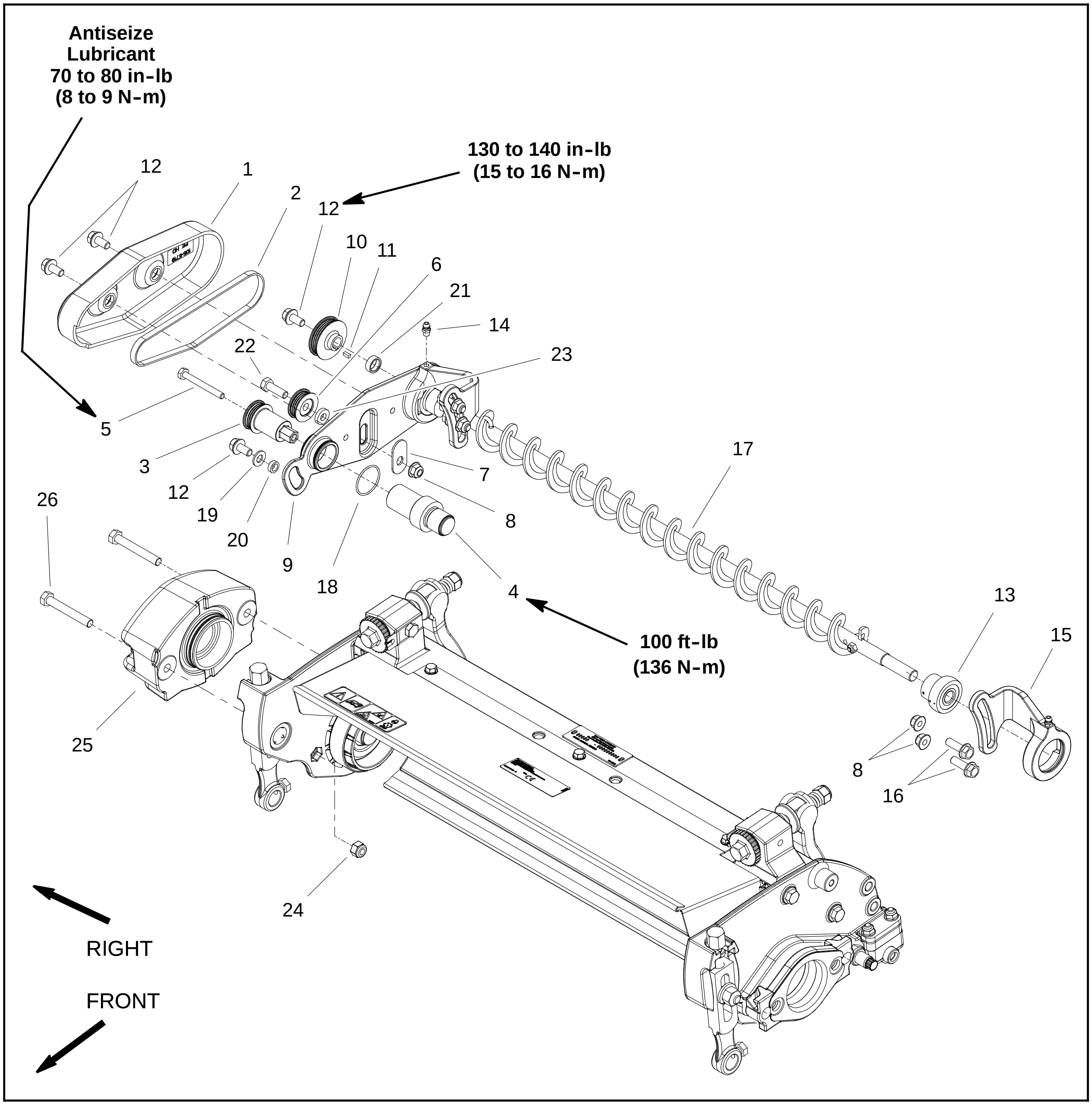
Antiseize Lubricant 70 to 80 in-lb (8 to 9 N-m)
130 to 140 in-lb (15 to 16 N-m)
100 ft-lb (136 N-m)
12
1
2
12
10
11
6
21
14
23
22
5
3
12
19
20
9
18
7
8
4
17
26
25
24
13
15
8
16
RIGHT
FRONT

Figure 38

1. **Cover**
2. **Drive belt**
3. **Drive pulley**
4. **Pulley driver**
5. **Cap screw**
6. **Idler pulley assembly**
7. **Cover plate**
8. **Flange nut (5 used)**
9. **Drive plate**
10. **Driven pulley**
11. **Square key**
12. **Threadlock screw (4 used)**
13. **Roller bearing assembly (2 used)**
14. **Grease fitting (2 used)**
15. **LH brush support**
16. **Flange head screw (4 used)**
17. **Brush assembly**
18. **O-ring**
19. **Flat washer**
20. **Bearing spacer**
21. **Spacer**
22. **Cap screw**
23. **Bearing spacer**
24. **Hex nut (2 used)**
25. **Weight**
26. **Cap screw (2 used)**

NOTE: Drive components for the rear roller brush are located on the right side of the cutting unit.

NOTE: The Installation Instructions for the rear roller brush kit has detailed information regarding assembly and adjustment. Use those Instructions along with this Service Manual when servicing the rear roller brush.

Disassembly (Fig. 38)

1. Position machine on a clean and level surface, lower cutting units, stop engine, engage parking brake and remove key from the ignition switch.

2. To remove roller brush from brush shaft:

   A. Loosen set screw in the bearing locking collar on left side of brush shaft.

   B. Using blind hole in bearing locking collar as an impact point, unlock collar by striking it with a punch in the opposite direction of brush rotation.

   C. Remove the LH brush support (item 15), bearing and locking collar from brush shaft and cutting unit.

   D. Remove lock nut and J–bolt from both ends of the brush (Fig. 39).

   E. While rotating brush, slide brush from the shaft.

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

3. To remove roller brush drive belt (item 2):

   A. Loosen cap screw (item 22) and flange nut (item 8) that secure idler pulley assembly (item 6) to drive plate.

   B. Move idler pulley to loosen drive belt.

   C. Carefully remove drive belt from drive, driven and idler pulleys.

4. Disassemble roller brush components as necessary using Figure 38 as a guide.

Assembly (Fig. 38)

1. If roller brush was removed from brush shaft, slide brush onto shaft while rotating brush. Secure brush to shaft with two (2) J–bolts and lock nuts. Make sure that the J–bolts are installed with the threaded portion on the outside of the brush (Fig. 39). Torque lock nuts from **20 to 25 in–lb (2.3 to 2.8 N–m)**.

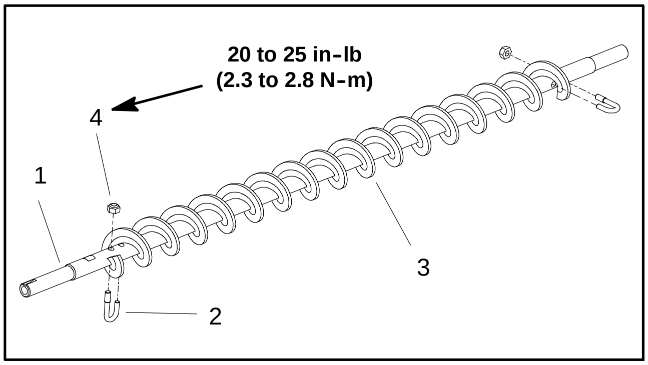

Figure 39

1. Roller brush shaft	**3. Roller brush**
2. J–bolt	**4. Lock nut**

2. Assemble roller brush components using Figure 38 as a guide and the following assembly notes:

   A. The screws (item 12) that are used to secure the cover (item 1), driven pulley (item 10) and drive plate (item 9) have a threadlock feature to prevent the screws from loosening. If original screws are being re–used during assembly, apply Loctite #242 (or equivalent) to threads of screws.

   B. .Apply a light coating of grease to O–ring (item 18) before installing on drive plate flange. Make sure that O–ring is correctly positioned in groove in flange.

   C. Apply antiseize lubricant to threads of cap screw (item 5) that retains drive pulley (item 3). Torque cap screw from **70 to 80 in–lb (8 to 9 N–m)** to secure drive pulley to pulley driver.

   D. Secure driven pulley (item 10) to brush shaft with threadlock screw (item 12). Torque screw from **130 to 140 in–lb (15 to 16 N–m)**.

   E. Secure pulley driver (item 4) to cutting reel shaft with **100 ft–lb (136 N–m)** torque.

3. If either of the bearing locking collars was loosened, tighten locking collar onto brush shaft:

   A. Slide locking collar outward on brush shaft onto the bearing collar. Rotate locking collar by hand in the direction of normal brush rotation until the collar is tight on the shaft.

   B. Using blind hole in bearing locking collar as an impact point, lock collar by striking it with a punch in the normal direction of brush rotation.

   C. Tighten set screw in locking collar to secure the bearing assembly to the brush shaft.

IMPORTANT: The brush drive belt may fail prematurely if the pulleys are not properly aligned.

4. Check alignment of pulleys with a straight edge placed along the outer face of the pulleys (Fig. 40). The outer faces of the drive, driven and idler pulleys should be aligned. If necessary to align pulleys, loosen locking collars on brush bearings and move brush assembly until pulleys are aligned. Once pulleys are aligned, secure brush with bearing locking collars.

IMPORTANT: Make sure that idler pulley is loosened before installing brush drive belt.

5. To install brush drive belt (item 2):

   A. Make sure that idler pulley (item 6) is loose on drive plate.

   B. Carefully install drive belt around drive, driven and idler pulleys.

   C. After belt installation, make sure that belt and pulley grooves are aligned and that belt is centered in pulleys.

6. To tension the drive belt:

   A. Push down on the idler pulley and secure with cap screw (item 22) and flange nut (item 8). Make sure that cover plate (item 7) is covering the slot in the drive plate to prevent debris from entering the brush drive area.

   B. After idler pulley is secured, check that drive belt has approximately 1/4” (6 mm) deflection at the center of the belt with 2 lb (1 kg) of force applied to the belt (Fig. 41).

7. Check that roller brush is parallel to rear roller with 0.010” (0.25 mm) clearance to light contact with roller. If contact is incorrect, brush operation will be adversely affected.

8. Lubricate grease fittings on brush support and drive plate until grease is visible. Wipe up excess grease.

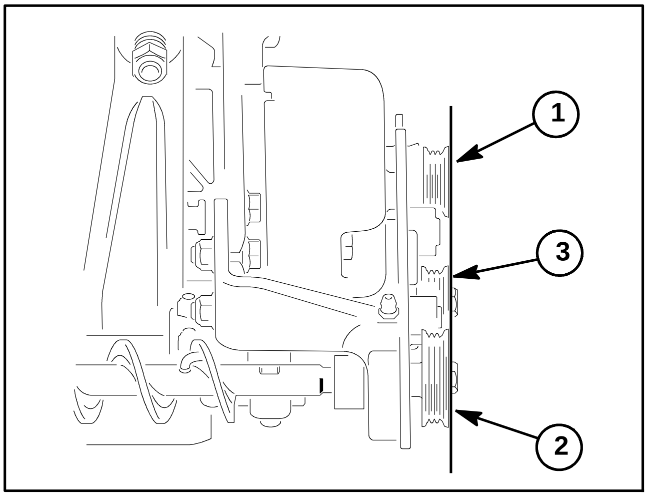

Figure 40

1. **Drive pulley**
2. **Driven pulley**
3. **Idler pulley**
4. **Drive belt**

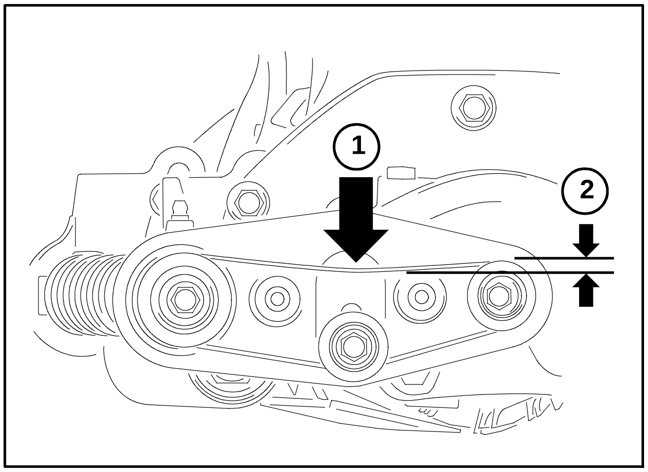

Figure 41

1. **2 lb (1 kg) of force**
2. **1/4” (6 mm) deflection**

Chapter 9

Groomer

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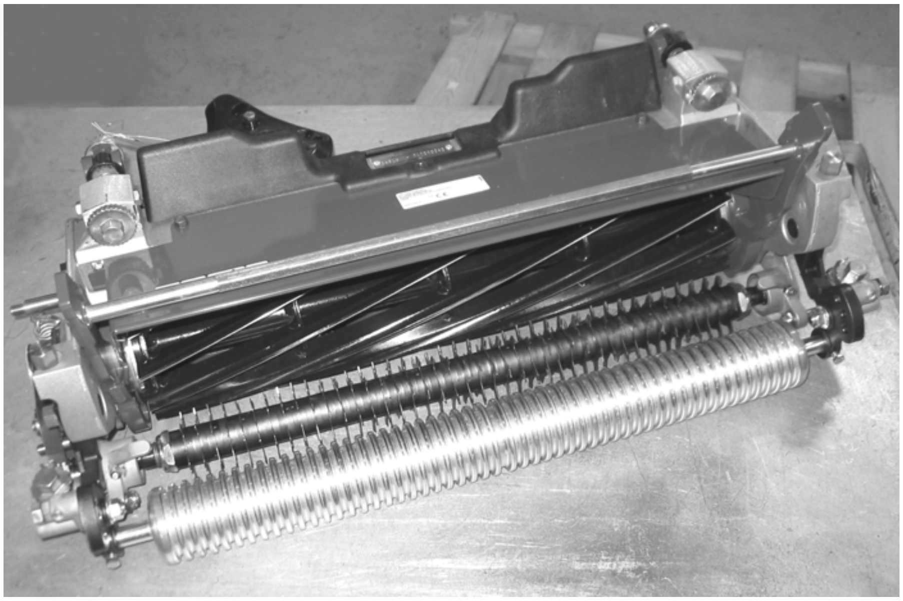
Specifications



MOUNTING: The groomer is mounted to the DPA cutting unit side plates.

GROOMING REEL CONSTRUCTION: 2.375 inch (6 cm) diameter, 41 steel blades with 1/2 inch blade spacing. Blade spacing can be adjusted to 1/4 inch or 3/4 inch by altering the number and position of blade spacers on the groomer. Grooming reel is available with either steel or carbide tipped blades. Groomer brush can be installed in place of grooming reel.

GROOMER HEIGHT SETTING: From 0.030 to 0.620 inch (0.8 to 15.7 mm) at mowing HOC range of 0.060 to 0.750 inch (1.5 to 19.1 mm).

WIDTH-OF-GROOMER: 19.380 inches (49.2 cm).

HEIGHT ADJUSTMENT KNOB: Allows a 0.003 inch (0.08 mm) increment of height adjustment for each click of the adjuster.

UP-DOWN FEATURE: Allows grooming reel to be raised above the height/depth adjustment for no grooming reel action while cutting.

GROOMER DRIVE: Both forward rotating and counter rotating groomer drive systems are available for the Greensmaster 3320 and 3420. The groomer drive assembly is attached to the right side of the cutting unit.

General Information

Installation Instructions

The installation instructions for the groomer provide information regarding the operation, general maintenance procedures and maintenance intervals for the groomer assembly on your Greensmaster TriFlex Hybrid machine. Refer to this publication for additional information when servicing the groomer assembly.

Opening Electrical Circuit to Cutting Units

CAUTION

Before installing, removing or servicing the cutting units, separate the cutting unit power disconnect. This will prevent unexpected cutting unit operation.

Before installing, removing or working on the cutting units, disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (Fig. 1). The couplers are located at the base of the rollover bar on the left side of the traction unit. Connect the couplers together before operating the machine.

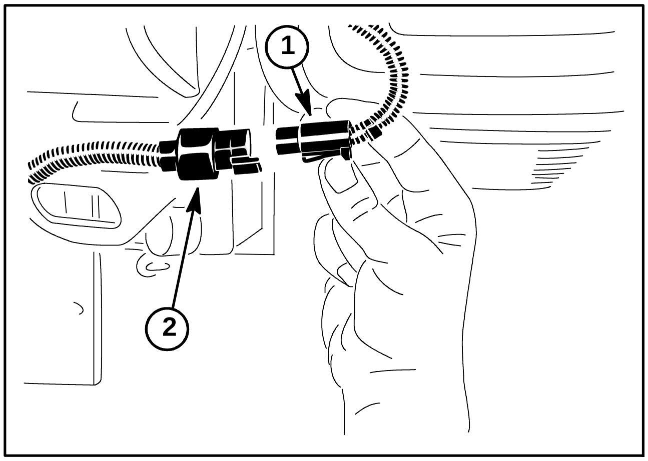


Figure 1

1. **Coupler**
2. **Stationary coupler**

Troubleshooting

Factors Affecting Grooming

There are a number of factors that can affect the performance of grooming. These factors vary for different golf courses and from green to green. It is important to inspect the turf frequently and vary the grooming practice with turf needs.

It is important to remember that factors affecting quality of cut also affect grooming performance.

IMPORTANT: Improper or overaggressive use of the grooming reel, such as too deep or frequent grooming, may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer carefully. READ AND UNDERSTAND THE OPERATION INSTRUCTIONS BEFORE OPERATING OR TESTING GROOMER PERFORMANCE.

Variables That Affect the Use and Performance of Grooming Reels:

1. The growing season and weather conditions.
2. General turf conditions.
3. The frequency of grooming/cutting – number of cuttings per week and how many passes per cutting.
4. The blade spacing on the grooming reel.
5. The height–of–cut.
6. The grooming depth.
7. The type of grass on the green.
8. The amount of time that a grooming reel has been in use on a particular turf area.
9. The amount of traffic on the turf.
10. The overall turf management program (e.g. irrigation, fertilizing, weed control, coring, overseeding, disease control, sand dressing and pest control).
11. Stress periods for turf (e.g. high temperatures, high humidity, unusually high traffic).

Grooming Reel Mechanical Problems

Problem	Possible Causes	Correction
The grooming reel rotates when it is in the raised, transport position (forward rotating groomer drive).	The grooming reel should rotate whenever the cutting reel is engaged.	Normal operation.
No rotation of the grooming reel (forward rotating groomer drive).	Seized grooming reel or idler bearing(s) in groomer side plate(s).	Identify and replace faulty bearing(s).
	Broken or damaged drive belt idler spring.	Replace idler spring.
	The groomer drive belt is worn, broken or damaged.	If the belt slips, it probably is worn and must be replaced. Repair or replace belt if necessary. A broken or worn belt could be the result of improper belt routing or seized bearings in groomer assembly.
No rotation of the grooming reel (counter rotating groomer drive).	Handle on groomer cover is rotated rearward so that groomer drive is disengaged.	Handle needs to be rotated toward the front of the machine to engage the groomer drive.
	Seized grooming reel or idler bearing(s) in groomer side plate(s).	Identify and replace faulty bearing(s).
	Broken or damaged drive idler spring.	Replace idler spring.
	Groomer drive gears are worn or damaged.	Inspect groomer drive assembly and replace damaged drive components.
The turf is damaged or has uneven grooming.	The groomer is set too aggressively.	Refer to groomer Installation Instructions for groomer set–up information.
	The grooming reel blades are bent, damaged or missing.	Repair or replace blades if necessary.
	The grooming reel shaft is bent or damaged.	Replace grooming reel shaft.
	Grooming depth is not equal on both ends of grooming reel.	Adjust depth if necessary. Check and adjust cutting unit set up (level bedknife to reel, level rear roller to reel, set height–of–cut, etc.).

Adjustments

CAUTION

Never work on the cutting unit with the engine running. Always stop the engine and remove the key from the ignition switch before working on the mower.

NOTE: See Cutting Unit Operator's Manual for adjustment procedures for the cutting units on your Greensmaster.

Height/Depth of Groomer Adjustment

NOTE: Grooming is performed above the soil level. When adjusting groomer height/depth, groomer blades should never penetrate the soil.

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Make sure rollers are clean and cutting reel is set to the desired height–of–cut (see Cutting Unit Operator's Manual for cutting unit adjustment procedures).

4. Position the grooming reel to the lowered, grooming position (Fig. 2).

NOTE: Improper or over–aggressive use of the grooming reel (i.e. too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe greens damage. Use the groomer cautiously.

5. On one end of the grooming reel, measure the distance from the lowest tip of the groomer blade to the working surface. Lift and turn height adjustment knob to raise or lower the blade tip (Fig. 2). Each notch on the adjustment knob changes the groomer height approximately 0.003 inch (0.08 mm).

6. Repeat step 4 on the opposite end of the groomer. Then, recheck setting on the first side of groomer. Height setting on both ends of groomer should be identical.

7. After groomer adjustment is correct, connect the cutting unit power disconnect couplers.

FORWARD ROTATING GROOMER SHOWN

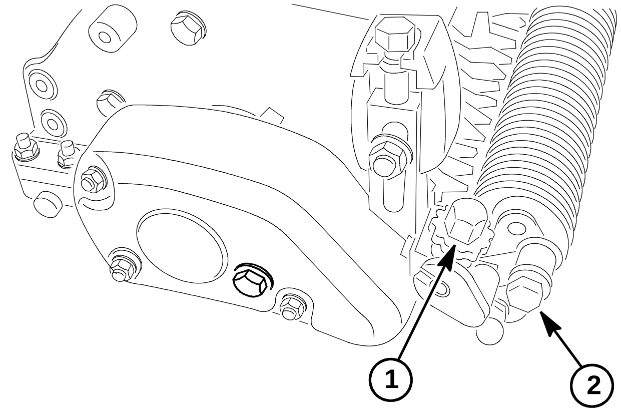


Figure 2

1. **Height adjustment knob**
2. **Lock screw**

Service and Repairs

Groomer Belt Replacement (Forward Rotating Groomer Drive)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. If equipped, remove rear roller brush from cutting unit (see Rear Roller Brush Removal in the Service and Repairs section of Chapter 8 – DPA Cutting Units).

4. Remove three (3) lock nuts that secure groomer drive cover, then remove cover (Fig. 3).

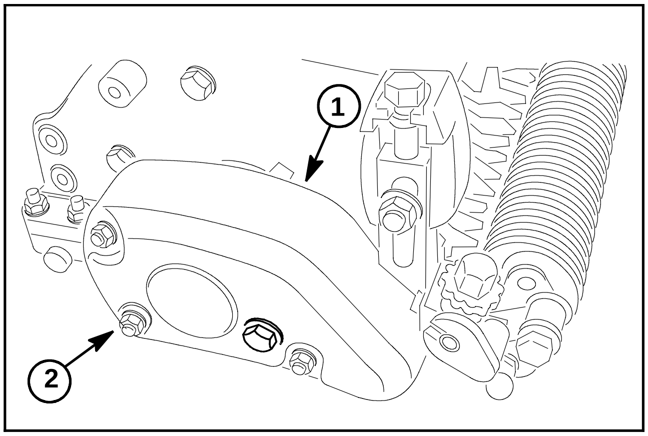


Figure 3

1. **Groomer drive cover**
2. **Lock nut (3 used)**

5. Pivot idler pulley by placing a 12mm wrench on pulley nut and rotating idler bracket to relax belt tension. Slip groomer drive belt off pulleys (Fig. 4). Carefully release idler bracket.

IMPORTANT: Make sure that the drive belt is centered on the pulleys and correctly aligned with pulley grooves after installation.

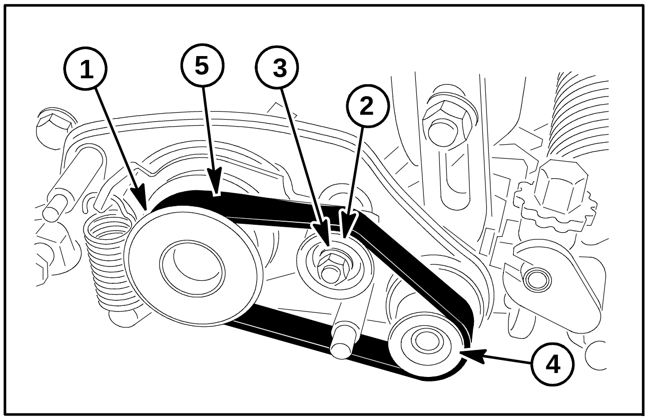


Figure 4

1. **Drive pulley**
2. **Idler pulley**
3. **Idler pulley nut**
4. **Driven pulley**
5. **Groomer drive belt**

6. Install new drive belt to drive pulley, idler pulley and driven pulley observing correct belt routing (Fig. 4).

7. Secure belt cover to machine with three (3) lock nuts (Fig. 3).

8. If equipped, install rear roller brush to cutting unit (see Rear Roller Brush Installation in the Service and Repairs section of Chapter 8 – DPA Cutting Units).

9. After belt installation is complete, connect the cutting unit power disconnect couplers.

Groomer Cover (Counter Rotating Groomer Drive)

On TriFlex machines with the counter rotating groomer, the groomer cover includes a handle which engages and disengages the groomer drive. When the handle is rotated toward the front of the machine, the groomer is engaged.

Removal

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. If equipped, remove rear roller brush from cutting unit (see Rear Roller Brush Removal in the Service and Repairs section of Chapter 8 – DPA Cutting Units).

4. Make sure that handle on groomer cover is rotated toward front of machine so that groomer drive is engaged.

5. Remove groomer cover assembly from machine (Fig. 5):

A. Remove five (5) flange head screws that secure groomer cover assembly to RH drive plate.

B. Remove groomer cover assembly and gasket from machine. Discard gasket.

6. If necessary, remove shaft from groomer cover (Fig. 6):

A. Loosen set screw (item 9) on top of shaft and slide handle from shaft.

B. Remove retaining ring (item 8) and thrust washer (item 5) from shaft.

C. Remove plunger detent (item 6) from groomer cover.

D. Slide shaft out of groomer cover. Remove and discard O–ring (item 4) from shaft.

7. Remove grease from inside groomer cover and RH drive plate on cutting unit. Thoroughly clean and inspect all groomer drive components.

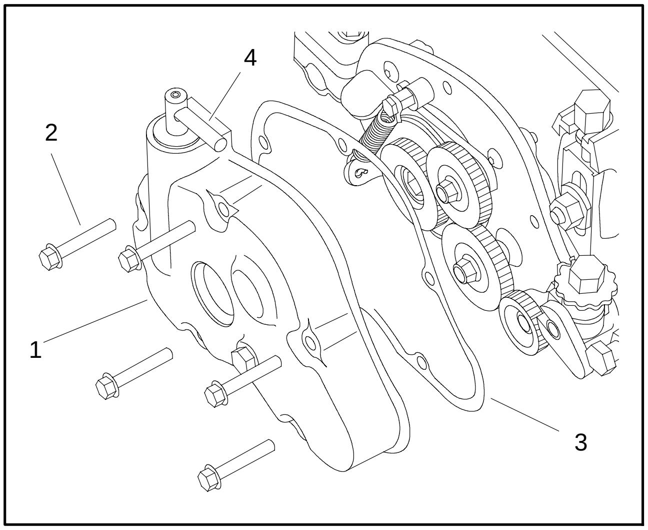


Figure 5

1. **Groomer cover assembly**
2. **Screw (5 used)**
3. **Gasket**
4. **Handle**

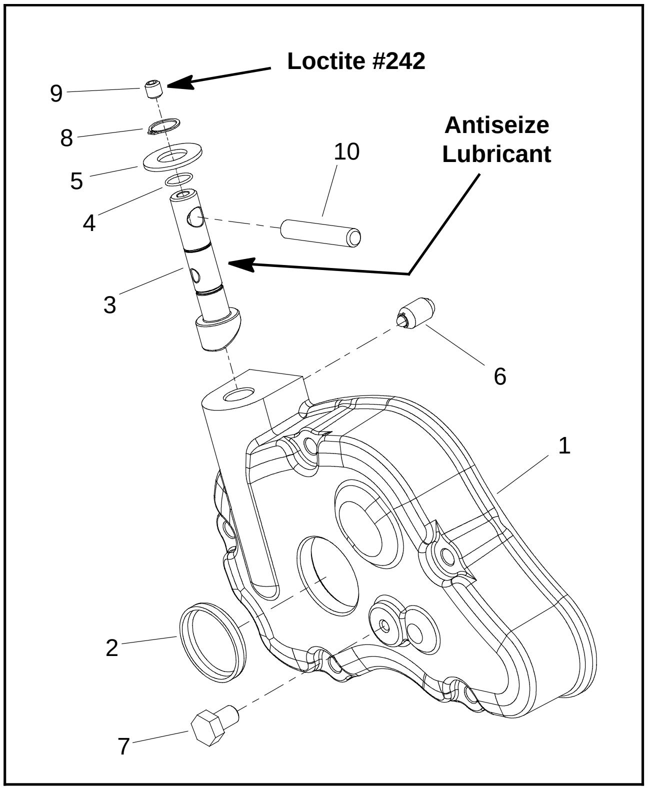


Figure 6

1. **Groomer cover**
2. **Plug**
3. **Shaft**
4. **O–ring**
5. **Thrust washer**
6. **Plunger detent**
7. **Cap screw**
8. **Retaining ring**
9. **Set screw**
10. **Handle**

Installation

1. If removed, install shaft into groomer cover (Fig. 6):

   A. Install new O–ring into groove of shaft.

   B. Apply antiseize lubricant to shaft surface that is below the retaining ring groove.

   C. Slide shaft up through bore of cover and secure with thrust washer and retaining ring. Position shaft in cover so that cam point of shaft is located away from the gasket surface (Fig. 7).

   D. Install plunger detent into groomer cover so that end of plunger if from **flush to 0.020” (0.5 mm)** extending from cover surface (Fig. 7).

   E. Slide handle into shaft so that it extends toward the front of the cover.

   F. Apply Loctite #242 (or equivalent) to threads of set screw. Install set screw into end of shaft to secure handle in place.

2. Install groomer cover assembly to RH drive plate assembly (Fig. 5):

   A. Make sure that handle on groomer cover is rotated toward the front of the machine.

   B. Fill groomer cover with approximately five (5) ounces (142 grams) of Mobil XHP221 grease (or equivalent).

   C. Install new gasket and then groomer cover assembly to RH drive plate. Secure cover with five (5) flange head screws.

3. If equipped, install rear roller brush to cutting unit (see Rear Roller Brush Installation in the Service and Repairs section of Chapter 8 – DPA Cutting Units).

4. After belt installation is complete, connect the cutting unit power disconnect couplers.

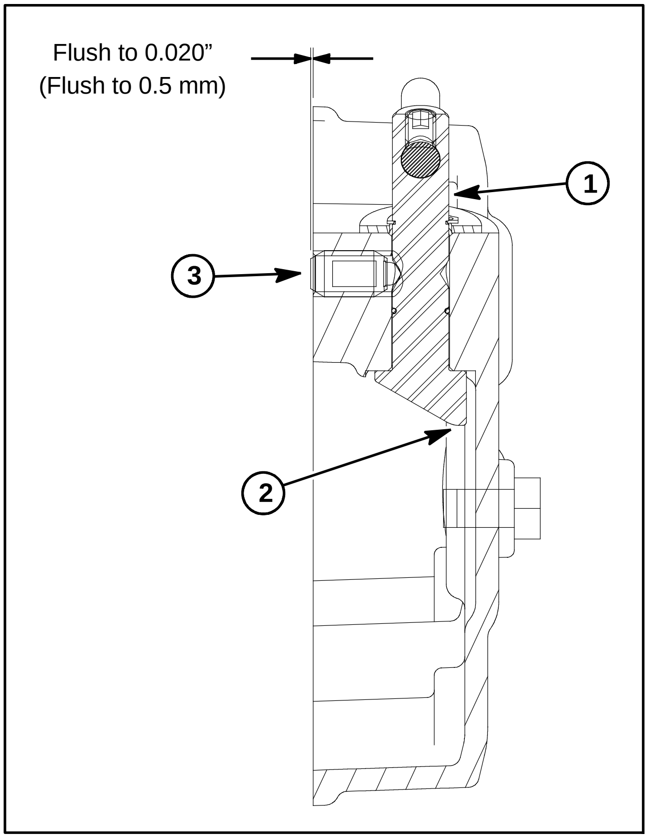


Figure 7

1. **Shaft**
2. **Cam point**
3. **Plunger detent**

Grooming Reel (Forward Rotating Groomer Drive)

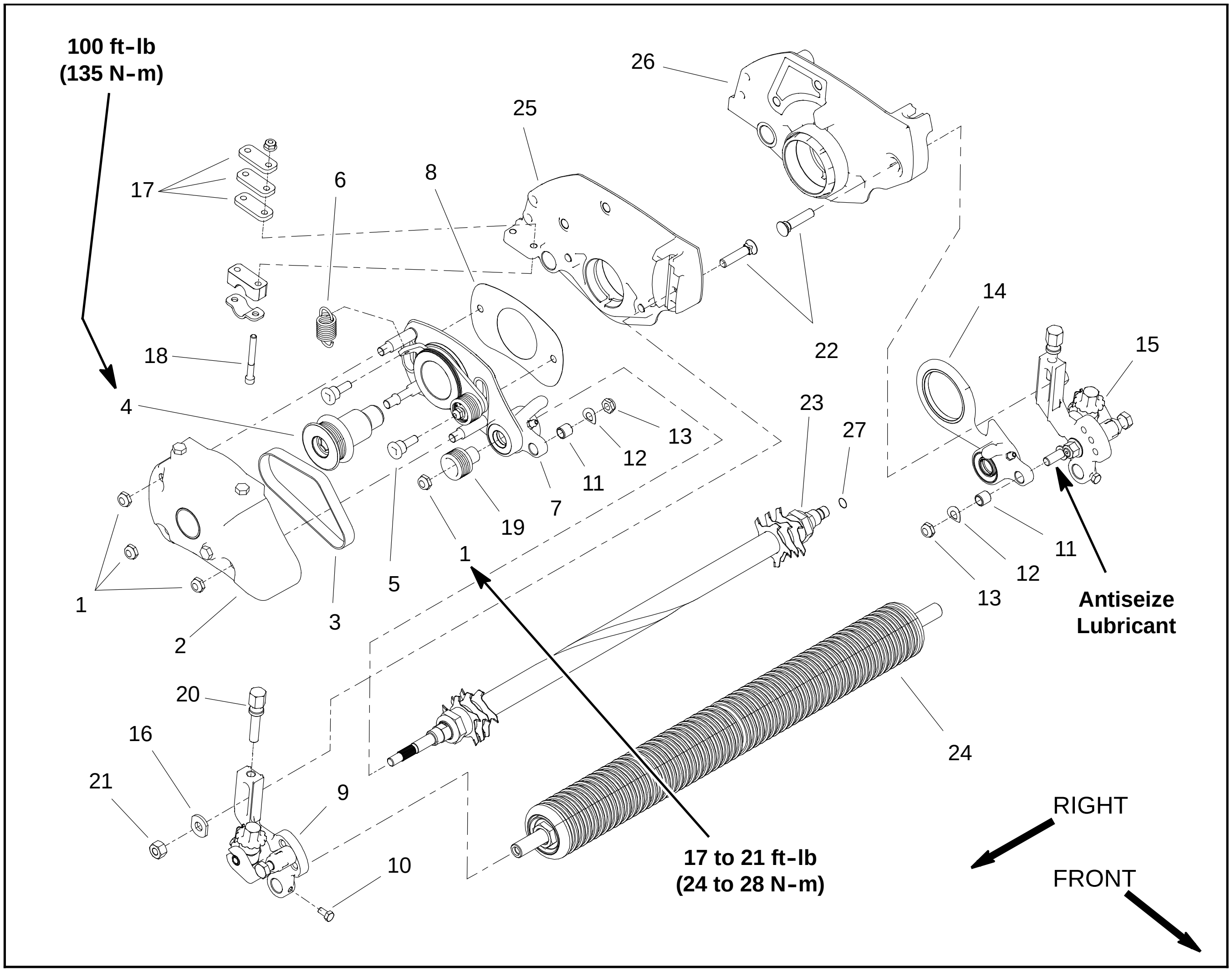


Figure 8

1. **Lock nut (4 used)**
2. **Drive cover**
3. **Groomer drive belt**
4. **Drive pulley**
5. **Shoulder bolt (2 used)**
6. **Spring**
7. **RH drive plate assembly**
8. **Groomer shim**
9. **RH groomer arm assembly**
10. **Cap screw (2 used)**
11. **Bushing (2 used)**
12. **Spring washer (2 used)**
13. **Lock nut (2 used)**
14. **LH support plate**
15. **LH groomer arm assembly**
16. **Special washer (2 used)**
17. **Rear roller height shim**
18. **Socket head screw (4 used)**
19. **Driven pulley**
20. **HOC screw (2 used)**
21. **HOC nut (2 used)**
22. **Plow bolt (2 used)**
23. **Grooming reel assembly**
24. **Front roller assembly**
25. **RH cutting unit sideplate**
26. **LH cutting unit sideplate**
27. **O-ring**

Remove the grooming reel to replace individual blades, to replace worn groomer components, to reverse the blades on the shaft (if not equipped with carbide blades) or to replace the grooming shaft.

Removal (Fig. 8)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Remove the cutting unit from the machine and place cutting unit on a flat work area.

4. If equipped, remove rear roller brush from cutting unit (see Rear Roller Brush Removal in the Service and Repairs section of Chapter 8 - DPA Cutting Units).

5. Remove groomer drive cover (item 2) and groomer drive belt (item 3) from groomer drive (see Groomer Belt Replacement in this section).

6. Loosen cap screws (item 10) that secure front roller shaft to groomer arms.

7. Remove lock nut (item 13) and spring washer (item 12) that secure RH groomer arm lift rod to RH drive plate assembly. Location of these items are shown in Figure 9.

8. Remove HOC nut (item 21), special washer (item 16) and plow bolt (item 22) that secure RH groomer arm assembly to RH drive plate assembly. Do not change height-of-cut screw adjustment. Remove RH groomer arm assembly from cutting unit.

9. Remove front roller assembly from cutting unit.

NOTE: To prevent grooming reel shaft from turning when removing driven pulley (item 19), use wrench on shaft flats to hold shaft.

10. Remove the lock nut (item 1) that secures driven pulley (item 19) to grooming reel shaft. Remove driven pulley from shaft.

NOTE: To prevent cutting reel from turning when removing drive pulley (item 4), block reel with piece of wood.

11. Loosen and remove drive pulley (item 4) from the cutting reel shaft.

12. Remove two (2) shoulder bolts (item 5) that secure the RH drive plate assembly to the cutting unit frame. Remove the groomer drive plate assembly from grooming shaft and cutting unit. Locate and retrieve groomer shim (item 8).

13. Carefully pull the grooming reel assembly from the LH support plate.

14. Inspect seals, bushings and bearings in RH drive plate, LH support plate and groomer arms for wear or damage. Also, inspect pulleys and idler components for wear or damage. Replace components as needed.

Installation (Fig. 8)

1. Apply a light coating of grease to ends of grooming shaft and also to seal lips in RH drive and LH support plates. Make sure that all bearings, bushings and seals are properly installed.

2. Make sure that O-ring (item 27) is installed on grooming shaft. Apply light coating of grease to O-ring.

3. Carefully place grooming reel assembly into the LH support plate taking care to not damage seal in support plate or O-ring on shaft.

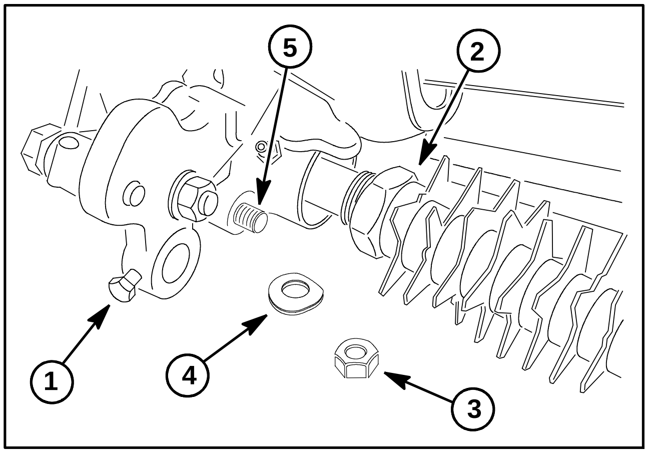


Figure 9

1. **Roller cap screw**
2. **Grooming reel assembly**
3. **Lock nut**
4. **Spring washer**
5. **Groomer arm lift rod**

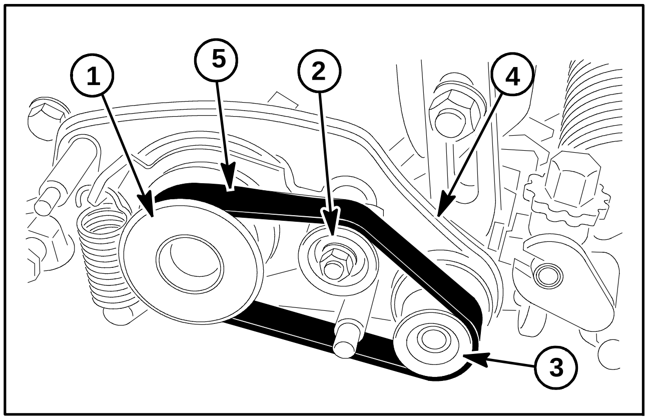


Figure 10

1. **Drive pulley**
2. **Idler pulley**
3. **Driven pulley**
4. **Drive plate assembly**
5. **Groomer drive belt**

4. Apply light coating of grease to O-ring on RH drive plate assembly pivot hub and pilot bore of cutting unit side plate.

5. Position groomer shim (item 8) to drive plate assembly.

6. Carefully place RH drive plate assembly onto groomer shaft taking care to not damage seals in drive plate. Position drive plate to the cutting unit frame and secure with two (2) shoulder bolts (item 5). Make sure that drive plate rotates freely after installation.

7. Apply light coating of grease to hub on driven pulley (item 19) taking care to not get grease on belt surface of pulley. Slide driven pulley onto the grooming reel shaft taking care to not damage seal in side plate.

NOTE: To prevent grooming reel shaft from turning when installing driven pulley (item 19), use wrench on shaft flats to hold shaft.

8. Secure driven pulley to grooming reel shaft with lock nut (item 1). Torque lock nut from **17 to 21 ft-lb (24 to 28 N-m)**.

NOTE: To prevent cutting reel from turning when installing drive pulley (item 4), block reel with piece of wood.

9. Secure drive pulley (item 4) to cutting reel shaft. Torque pulley to **100 ft-lb (135 N-m)**.

10. Insert front roller into LH groomer arm assembly.

11. Make sure that bushing (item 11) is installed in RH drive plate assembly.

12. Apply antiseize lubricant to threads of RH groomer arm lift rod.

13. Position RH groomer arm assembly to front roller, RH drive plate and cutting unit frame. Secure groomer arm to cutting unit with plow bolt (item 22), special washer (item 16) and HOC nut (item 21).

14. Secure RH groomer arm assembly to drive plate with spring washer (item 12) and lock nut (item 13).

15. Center front roller to cutting unit and tighten cap screws (item 10) to secure roller.

16. Install groomer drive belt (item 3) and groomer drive cover (item 2) to drive plate (see Groomer Belt Replacement in this section).

17. If equipped, install rear roller brush to cutting unit (see Rear Roller Brush Installation in the Service and Repairs section of Chapter 8 - DPA Cutting Units).

18. Check grooming reel height and mower height-of-cut settings. Adjust as needed.

19. Install cutting unit to the machine.

20. Lubricate groomer bearings (see Groomer Installation Instructions).

21. Connect the cutting unit power disconnect couplers.

NOTE: After greasing groomer bearings, operate groomer for 30 seconds, stop machine and wipe excess grease from groomer shaft and seals.

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Grooming Reel (Counter Rotating Groomer Drive)

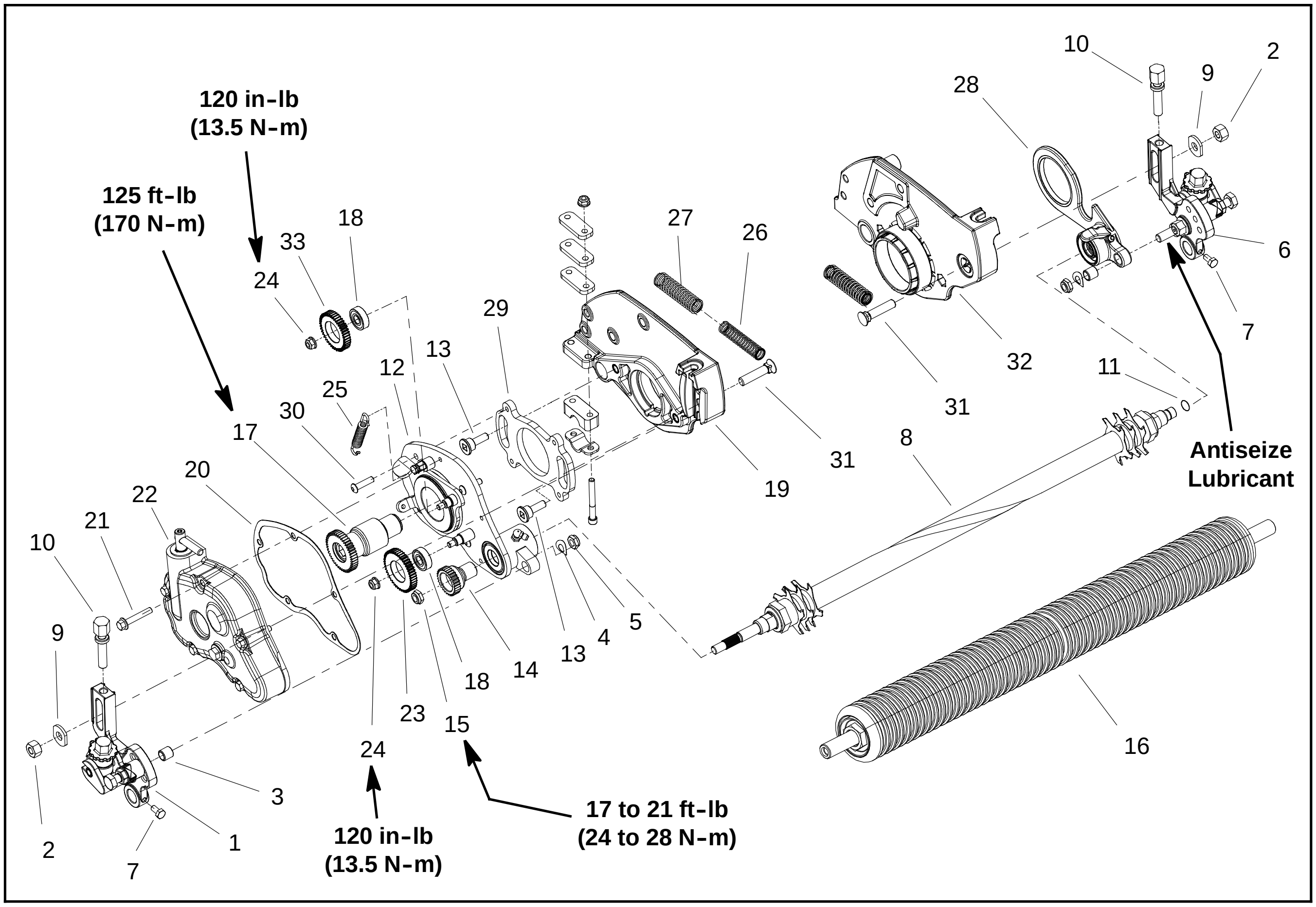

Figure 11

1. **RH groomer arm assembly**
2. **HOC nut (2 used)**
3. **Bushing (2 used)**
4. **Spring washer (2 used)**
5. **Lock nut (2 used)**
6. **LH groomer arm assembly**
7. **Cap screw (2 used)**
8. **Grooming reel assembly**
9. **HOC washer (2 used)**
10. **HOC screw (2 used)**
11. **O-ring**
12. **RH drive plate assembly**
13. **Shoulder bolt (2 used)**
14. **Driven gear (30T)**
15. **Lock nut**
16. **Front roller**
17. **Groomer drive gear (45T)**
18. **Bearing (2 used)**
19. **RH cutting unit side plate**
20. **Gasket**
21. **Flange head screw (5 used)**
22. **Groomer cover assembly**
23. **47T idler gear**
24. **Flange nut (2 used)**
25. **Extension spring**
26. **Inner spring (2 used)**
27. **Outer spring (2 used)**
28. **LH support plate assembly**
29. **Support plate**
30. **Button head screw (4 used)**
31. **Plow bolt (2 used)**
32. **LH cutting unit side plate**
33. **43T idler gear**

Remove the grooming reel to replace individual blades, to replace worn groomer components, to reverse the blades on the shaft (if not equipped with carbide blades) or to replace the grooming shaft.

Removal (Fig. 11)

1. Park machine on a clean, level surface. Lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Remove the cutting unit from the machine and place cutting unit on a flat work area.

4. Make sure that handle on groomer cover is rotated toward front of machine so that groomer drive is engaged.

5. Remove groomer cover assembly (item 22) and gasket (item 20) from machine (see Groomer Cover (Counter Rotating Groomer Drive) in this section). Discard gasket.

6. Carefully remove extension spring from anchor points on RH drive plate (Fig. 12).

7. Remove the two (2) idler gears (43T and 47T) from the RH drive plate assembly (Fig. 13). The bearings are pressed into the gears.

8. Loosen cap screws (item 7) that secure front roller shaft to groomer arms.

9. Remove lock nut and spring washer that secure RH groomer arm lift rod to RH drive plate assembly (Fig. 14).

10. Remove HOC nut (item 2), HOC washer (item 9) and plow bolt (item 31) that secure RH groomer arm assembly to RH drive plate assembly. Do not change height-of-cut screw adjustment. Remove RH groomer arm assembly from cutting unit.

11. Remove front roller from cutting unit.

NOTE: To prevent grooming reel shaft from turning when removing driven gear (item 14), use wrench on shaft flats to hold shaft.

12. Remove the lock nut (item 15) that secures driven gear (item 14) to grooming reel shaft. Remove driven gear from shaft.

NOTE: To prevent cutting reel from turning when removing groomer drive gear (item 17), block reel with piece of wood.

13. Loosen and remove groomer drive gear (item 17) from the cutting reel shaft.

14. Remove four (4) button head screws (item 30) that secure the RH drive plate assembly (item 12) to the support plate on the cutting unit frame. Remove the RH drive plate assembly from grooming shaft and cutting unit.

15. Carefully pull the grooming reel assembly from the LH support plate.

16. Inspect seals, bushings and bearings in RH drive plate, LH support plate and groomer arms for wear or damage. Also, inspect gears and idler components for wear or damage. Replace components as needed.

Installation (Fig. 11)

1. Apply a light coating of grease to ends of grooming reel shaft and also to seal lips in RH drive plate and LH support plate. Make sure that all bearings, bushings and seals are properly installed.

2. Make sure that O-ring (item 11) is installed on grooming reel shaft. Apply light coating of grease to O-ring.

3. Carefully place grooming reel assembly into the LH support plate taking care to not damage seal in support plate or O-ring on shaft.

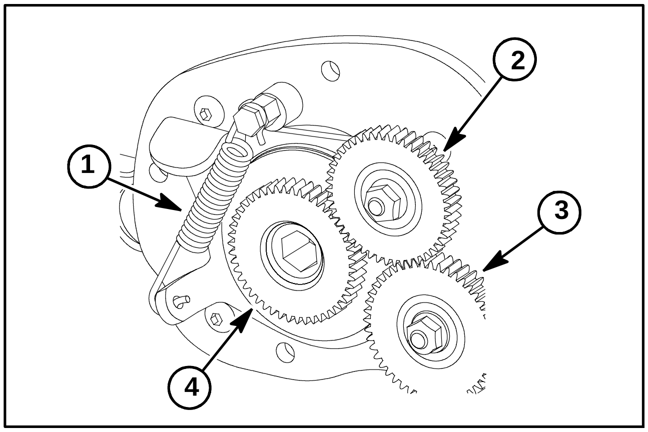

Figure 12

1. **Extension spring**
2. **43T idler gear**
3. **47T idler gear**
4. **Groomer drive gear**

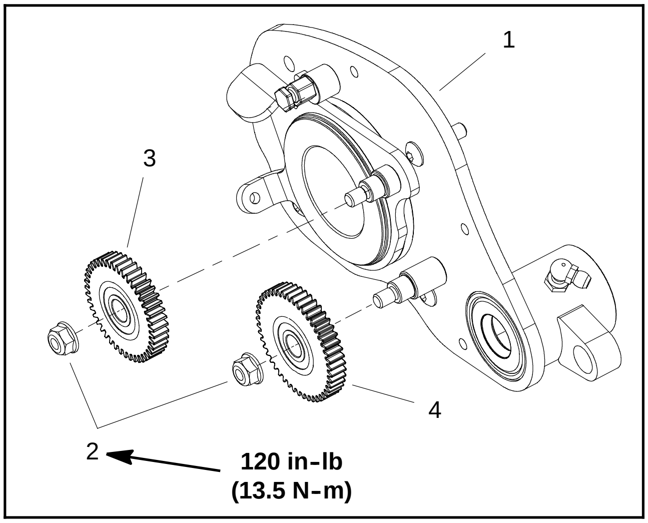

Figure 13

1. **RH drive plate assy**
2. **Flange nut**
3. **43T gear/bearing**
4. **47T gear/bearing**

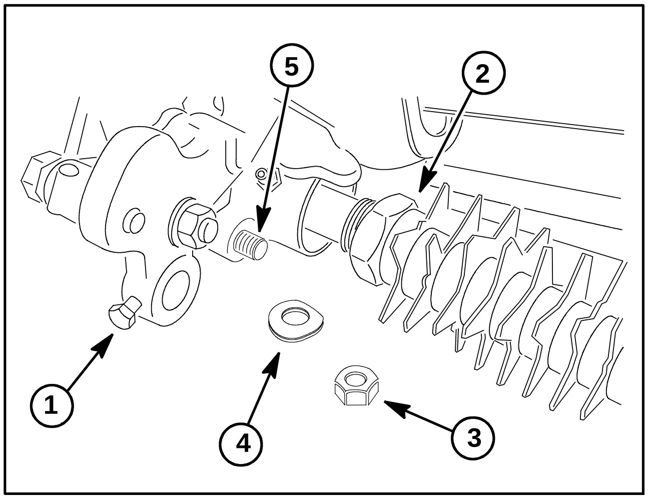

Figure 14

1. **Roller cap screw**
2. **Grooming reel assembly**
3. **Lock nut**
4. **Spring washer**
5. **Groomer arm lift rod**

4. Apply light coating of grease to O–ring on RH drive plate assembly pivot hub and pilot bore of cutting unit side plate.

5. Carefully slide RH drive plate onto grooming reel shaft taking care to not damage seals in drive plate. Position drive plate to the support plate on the cutting unit frame and secure with four (4) button head screws (item 30). Make sure that drive plate rotates freely after installation.

6. Install driven gear (item 14) onto grooming reel shaft:

   A. Apply light coating of grease to hub on driven gear (item 14).

   B. Carefully slide driven gear onto the grooming reel shaft taking care to not damage seal in drive plate.

   NOTE: To prevent grooming reel shaft from turning when securing driven gear, use wrench on shaft flats to hold shaft.

   C. Secure gear to shaft with lock nut (item 15). Torque lock nut from **17 to 21 ft–lb (24 to 28 N–m)**.

NOTE: To prevent cutting reel from turning when installing groomer drive gear (item 17), block reel with piece of wood.

7. Secure groomer drive gear (item 17) to cutting reel shaft. Torque gear to **125 ft–lb (170 N–m)**.

8. Install the two (2) idler gears (43T and 47T) to RH drive plate assembly (Fig. 13). Secure gears with flange nuts and torque flange nuts **120 in–lb (13.5 N–m)**.

9. Install extension spring to RH drive plate assembly (Fig. 12).

10. Insert front roller into LH groomer arm assembly.

11. Make sure that bushing (item 3) is installed in RH drive plate assembly.

12. Apply antiseize lubricant to threads of RH groomer arm lift rod.

13. Position RH groomer arm assembly to front roller, RH drive plate and cutting unit frame. Secure groomer arm to cutting unit with plow bolt (item 31), HOC washer (item 9) and HOC nut (item 2).

14. Secure RH groomer arm assembly to drive plate with spring washer (item 4) and lock nut (item 5).

15. Center front roller to cutting unit and tighten cap screws (item 7) to secure roller.

16. Fill groomer cover with approximately five (5) ounces (142 grams) of Mobil XHP221 grease (or equivalent). Install new gasket and then groomer cover assembly to RH drive plate (see Groomer Cover (Counter Rotating Groomer Drive) in this section).

17. Check grooming reel height and mower height–of–cut settings. Adjust as needed.

18. Install cutting unit to the machine.

19. Lubricate groomer bearings (see Groomer Installation Instructions).

20. Connect the cutting unit power disconnect couplers.

NOTE: After greasing groomer bearings, operate groomer for 30 seconds, stop machine and wipe excess grease from groomer shaft and seals.

Grooming Reel Service

Inspect grooming reel blades frequently for damage and wear. Straighten bent blades with a pliers. Replace blades that are worn or damaged.

Carbide tipped grooming blades (Fig. 16) should be replaced if the carbide tip is worn, loose or missing. Also, if the blade is eroded around the carbide insert, the blade should be replaced.

Grooming blades without a carbide tip (Fig. 17) should be replaced if worn or damaged. Blades without a carbide tip that are rounded to the midpoint of the blade tip can be reversed on the grooming shaft to extend the life of the blade.

Disassembly (Fig. 15)

1. Remove grooming reel from cutting unit (see Grooming Reel Removal in this section).

2. Remove lock nut from either end of the shaft (Fig. 15).

3. Remove spacers and blades from groomer shaft as necessary.

Assembly (Fig. 15)

1. Start by placing thick spacer against the lock nut installed on one end of groomer shaft. Then, place first blade against installed spacer (Fig. 15).

IMPORTANT: If groomer is equipped with blades with carbide tips, make sure that blades are installed with the tips in the same direction.

2. For 1/2 inch (1.3 cm) blade spacing, make sure there are two (2) blade spacers between blades (Fig. 15).

3. When all blades have been installed, place second thick spacer on shaft and then thread second lock nut onto the shaft.

4. Position lock nuts to allow blades and spacers to be centered on the shaft (Fig. 18). Torque lock nuts from **200 to 250 in-lb (23 to 28 N-m)** so spacers are **not** free to rotate.

5. Install grooming reel back onto cutting unit (see Grooming Reel Installation in this section).

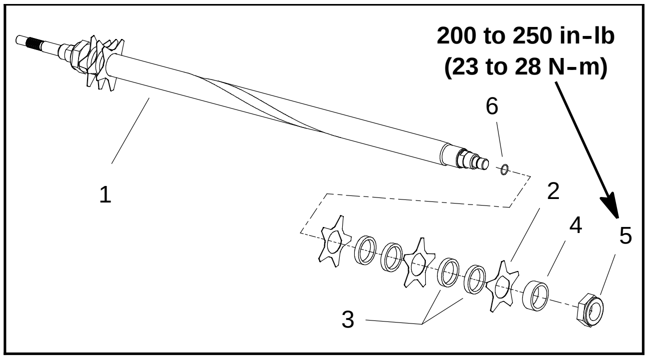

Figure 15

1. Grooming reel shaft	**4. Thick spacer (2 used)**
2. Groomer blade	**5. Lock nut (2 used)**
3. Blade spacer	**6. O-ring**

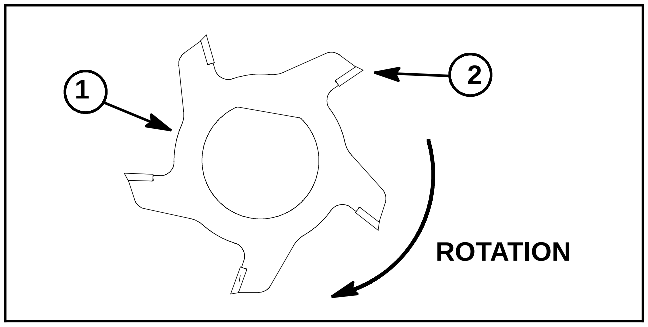

Figure 16

1. Grooming blade	**2. Carbide tip**

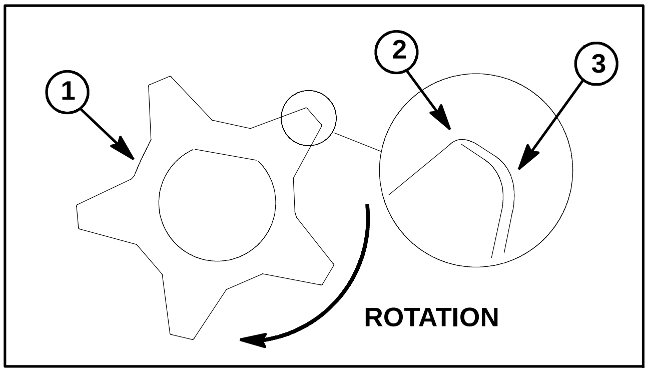

Figure 17

1. Grooming blade	**3. Dull (rounded) edge**
2. Sharp edge	

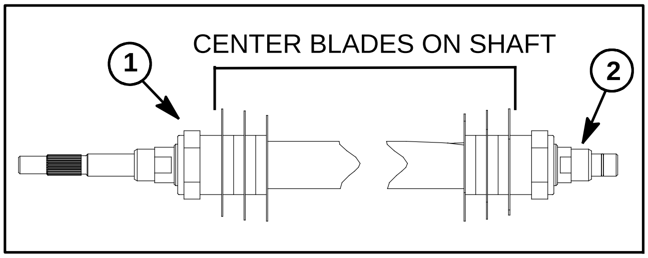

Figure 18

1. Lock nut	**2. Grooming shaft**

Grooming Reel Bearing Replacement

Bearing Removal

1. Park machine on a clean, level surface. Lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Remove the cutting unit from the machine and place cutting unit on a flat work area.

4. To remove groomer drive plate assembly from right side of cutting unit, remove front roller, grooming reel and then drive plate assembly (see Grooming Reel (Forward Rotating or Counter Rotating) in this section).

5. To remove support plate assembly from left side of cutting unit (Fig. 19):

A. Remove two (2) socket head screws and lock nuts that secure motor mount to cutting unit (Fig. 19). Remove motor mount from cutting unit.

B. Remove lock nut and spring washer that secure LH groomer arm lift rod to support plate (Fig. 20). Remove support plate from cutting unit.

6. Remove grooming reel seals and bearings from RH drive plate and LH support plate assemblies (Figs. 21, 22 and 23). Discard all removed seals and bearings.

Bearing Installation

1. Install new grooming reel bearings and seals into RH drive plate and LH support plate assemblies (Fig. 24):

IMPORTANT: Bearings should be installed with extended inner races toward center of housing. Also, apply pressure equally to inner and outer bearing races when installing bearings.

A. Press new outer bearing fully to shoulder of RH drive plate bore. Then, install new inner bearing until inner race contacts outer bearing race.

B. Press new bearing into LH support plate until it is flush with shoulder of bearing bore.

C. Install new seals into groomer side plates. **NOTE:** Seals should be installed so the lip side of the seal will face the center of the cutting reel. When bearings are greased, grease will purge from inner seals.

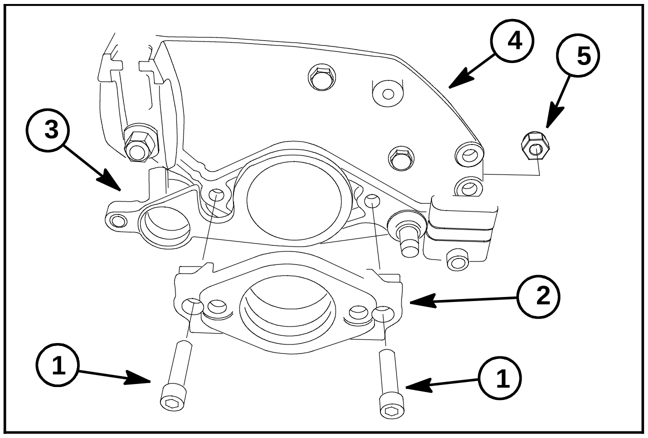

Figure 19

1. **Socket head screw**
2. **Motor mount**
3. **Groomer side plate (RH)**
4. **Cutting unit**
5. **Lock nut (2 used)**

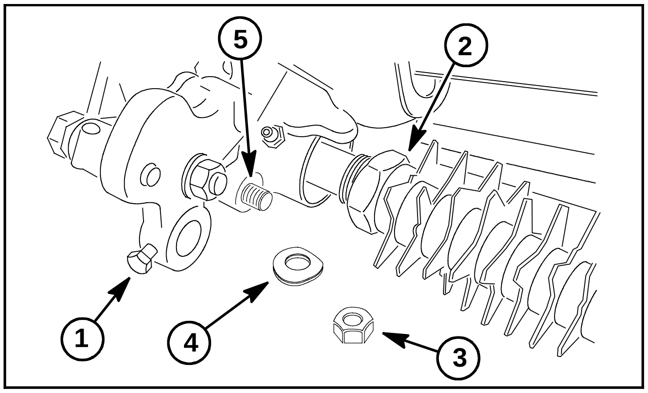

Figure 20

1. **Front roller cap screw**
2. **Grooming reel assembly**
3. **Lock nut**
4. **Spring washer**
5. **Groomer arm lift rod**

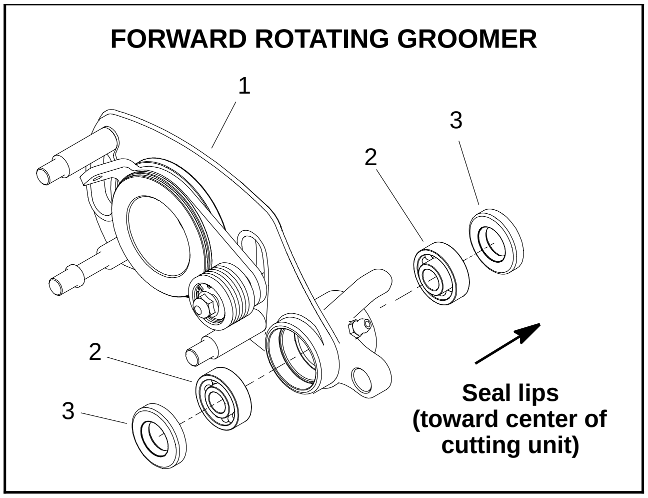

Figure 21

1. **RH drive plate assy**
2. **Bearing (2 used)**
3. **Seal (2 used)**

2. Install LH support plate to left side of cutting unit:

   A. Apply antiseize lubricant to threads of LH groomer arm lift rod.

   B. Position support plate to cutting unit making sure that LH groomer arm lift rod is positioned through bushing in support plate.

   C. Place spring washer and lock nut on lift rod threads (Fig. 20). Tighten lock nut.

   D. Position motor mount to groomer support plate (Fig. 19). Secure motor mount and support plate to cutting unit with two (2) socket head screws and lock nuts.

3. Install grooming reel, front roller and RH drive plate to cutting unit (see Grooming Reel (Forward Rotating or Counter Rotating) in this section).

4. Check and adjust grooming reel height and mower height-of-cut settings.

5. Install cutting unit to the machine.

6. Lubricate groomer bearings.

7. Connect the cutting unit power disconnect couplers.

NOTE: After greasing groomer bearings, operate groomer for 30 seconds, stop machine and wipe any excess grease from groomer shaft and seals.

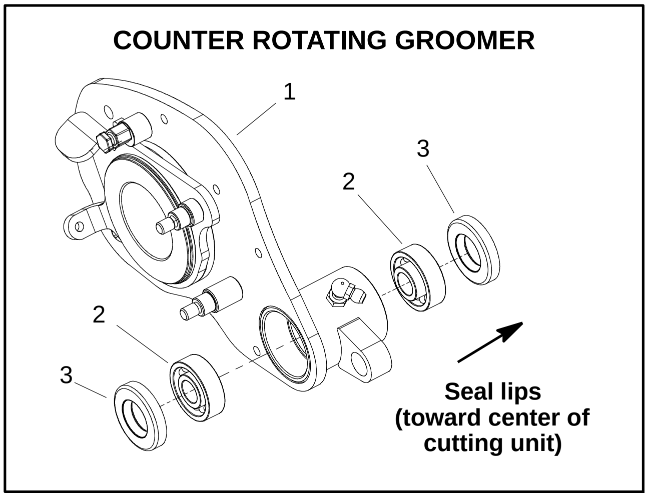

Figure 22

1. **RH drive plate assy**
2. **Bearing (2 used)**
3. **Seal (2 used)**

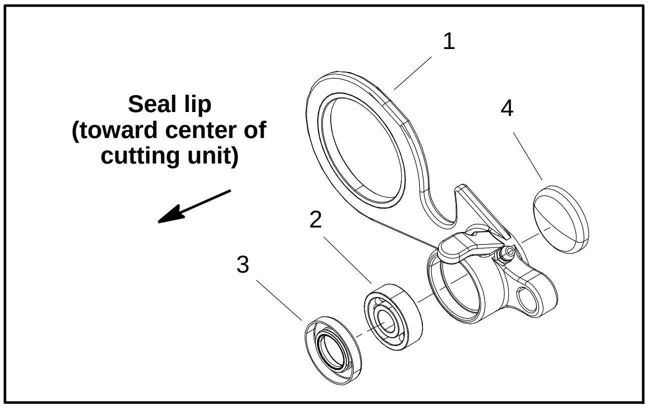

Figure 23

1. **LH support plate**
2. **Bearing**
3. **Seal**
4. **Plug**

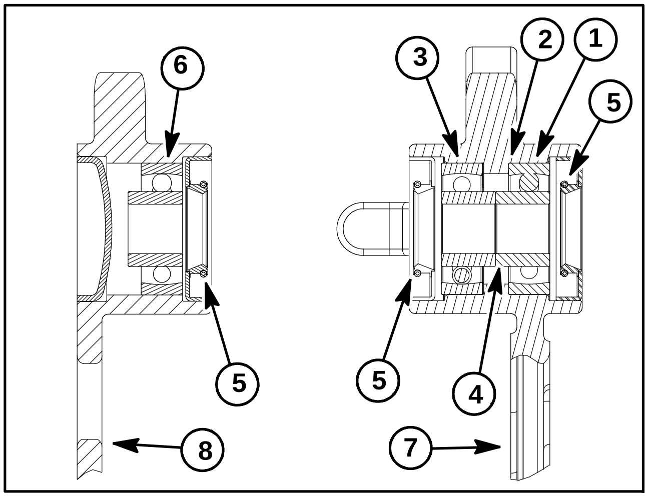

Figure 24

1. **Outer bearing**
2. **Drive plate shoulder**
3. **Inner bearing**
4. **Inner race**
5. **Seal lip**
6. **Support plate bearing**
7. **Drive plate (RH side)**
8. **Support plate (LH side)**

Idler Assembly (Forward Rotating Groomer Drive)

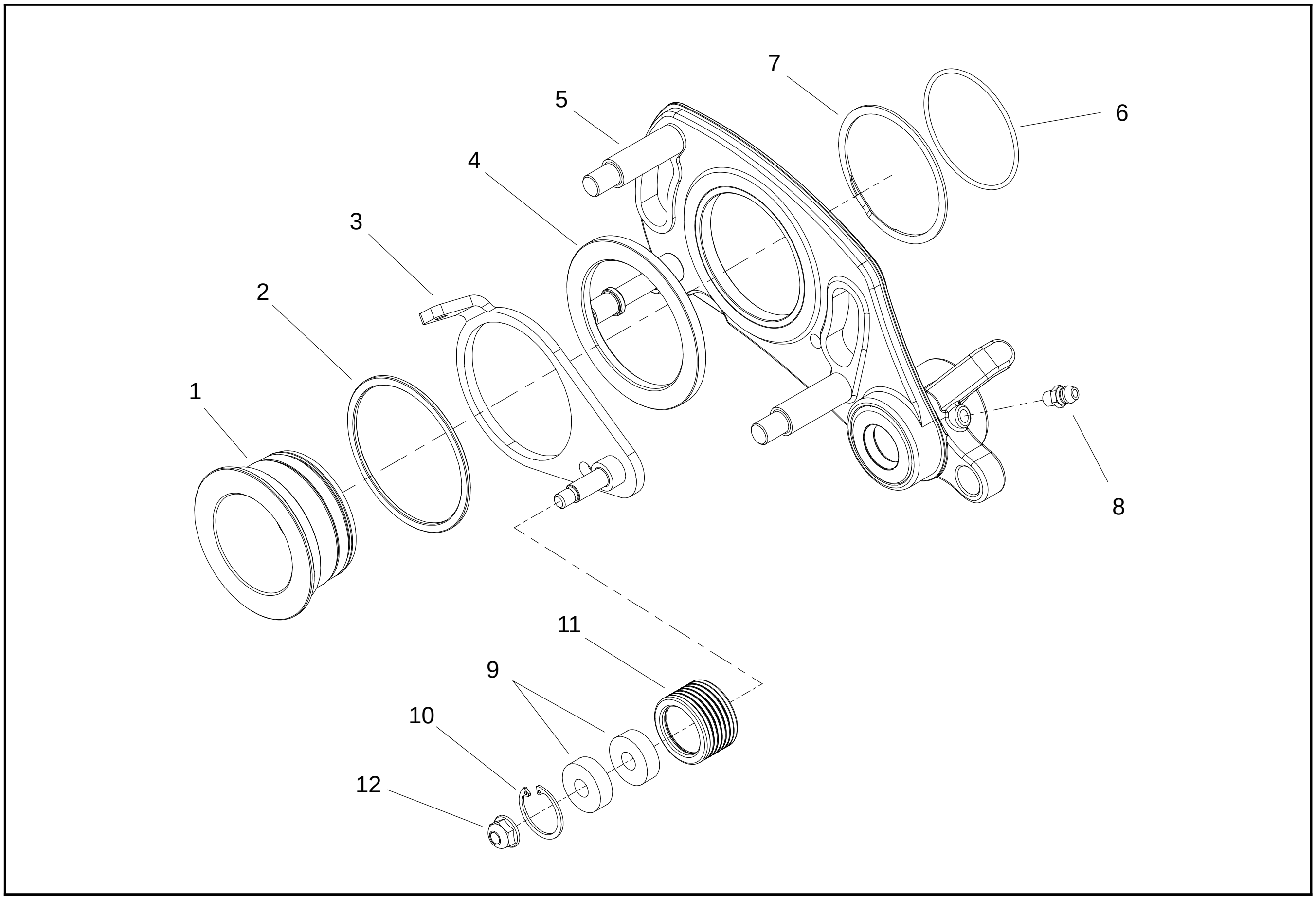

Figure 25

1. **Pivot hub**
2. **Spacer**
3. **Idler bracket**
4. **Spacer**
5. **RH drive plate**
6. **O-ring**
7. **Retaining ring**
8. **Grease fitting**
9. **Bearing (2 used)**
10. **Retaining ring**
11. **Idler pulley**
12. **Lock nut**

The groomer drive side plate assembly incorporates the idler system for tensioning the groomer drive belt. The idler system uses a spring to maintain proper belt tension.

Removal

1. Park machine on a clean, level surface. Lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Remove groomer belt cover, drive belt and drive pulley from right side of cutting unit (see Grooming Reel (Forward Rotating Groomer Drive) Removal in this section).

4. Using Figures 25 and 26 as guides, remove idler bracket, idler pulley and/or idler bearings as needed.

Installation

1. Assemble removed components using Figures 25 and 26 as guides.

NOTE: When properly installed, the idler pulley should move freely from side to side on the idler bracket pin.

2. Install drive pulley, drive belt and belt cover to right side of cutting unit (see Grooming Reel (Forward Rotating Groomer Drive) Installation in this section).

3. Check and adjust grooming reel height and mower height-of-cut settings.

4. Connect the cutting unit power disconnect couplers.

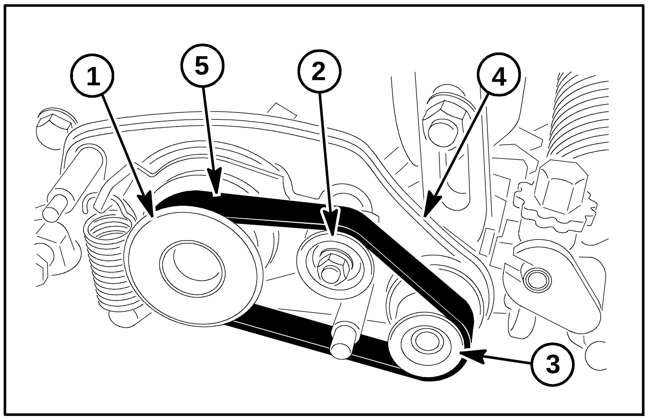

Figure 26

1. **Drive pulley**
2. **Idler pulley assembly**
3. **Driven pulley**
4. **Drive plate assembly**
5. **Groomer drive belt**

Idler Assembly (Counter Rotating Groomer Drive)

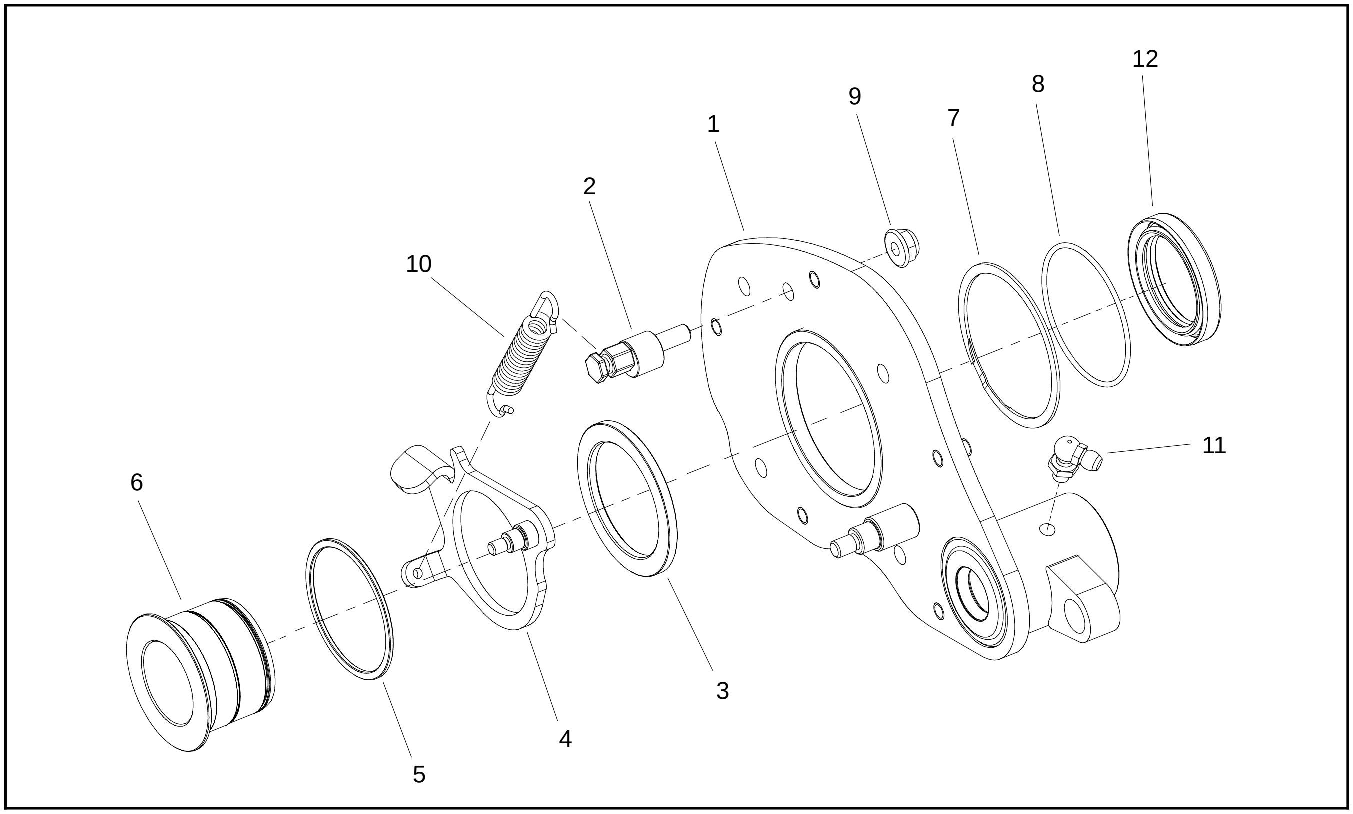

Figure 27

1. RH drive plate	**5. Spacer**	**9. Flange nut**
2. Adjustment cam	**6. Reel hub**	**10. Extension spring**
3. Spacer	**7. Retaining ring**	**11. Grease fitting**
4. Idler bracket	**8. O-ring**	**12. Grease seal**

The groomer RH drive plate assembly incorporates the idler system for engaging the groomer gear drive.

Disassembly (Fig. 27)

1. Park machine on a clean, level surface. Lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Make sure that handle on groomer cover is rotated toward front of machine so that groomer drive is engaged.

4. Remove groomer cover assembly and gasket from groomer drive on right side of cutting unit (see Groomer Cover (Counter Rotating Groomer Drive) in this section).

5. Remove RH drive plate assembly from right side of cutting unit (see Grooming Reel (Counter Rotating Groomer Drive) in this section).

6. Using Figure 27 as a guide, remove idler components from RH drive plate as needed.

Assembly (Fig. 27)

1. Assemble idler components to RH drive plate using Figure 27 as a guide. Make sure that retaining ring (item 7) is fully seated in groove of reel hub after assembly.

NOTE: When properly installed, the idler bracket (item 4) should pivot freely on reel hub.

2. Install RH drive plate assembly to right side of cutting unit (see Grooming Reel (Counter Rotating Groomer Drive) in this section). Make sure that groomer drive gear and grooming reel driven gear are properly torqued. Do not install idler gears, extension spring or groomer cover assembly to drive plate assembly at this time.

3. Check adjustment of adjustment cam (Fig. 29):

   A. Rotate idler bracket so the bracket stop is against the adjustment cam.

   B. While holding bracket stop against the cam, measure the distance between the idler gear bearing surfaces on the idler bracket and the drive plate. This distance should be **1.484” (37.7 mm)**.

   C. If distance is incorrect, loosen flange nut that secures adjustment cam to drive plate. Rotate the adjustment cam until distance is correct. Then, tighten flange nut to secure adjustment. Make sure that distance is still correct after tightening the nut.

4. Install idler gears to drive plate assembly (Fig. 30). Torque flange nuts that secure idler gears **120 in-lb (13.5 N-m)**.

5. Install extension spring to idler bracket and adjustment cam.

6. Fill groomer cover with approximately five (5) ounces (142 grams) of Mobil XHP221 grease (or equivalent). Install new gasket and then groomer cover assembly to RH drive plate (see Groomer Cover (Counter Rotating Groomer Drive) in this section).

7. Check and adjust grooming reel height and mower height-of-cut settings.

8. When all adjustments have been completed, connect the cutting unit power disconnect couplers.

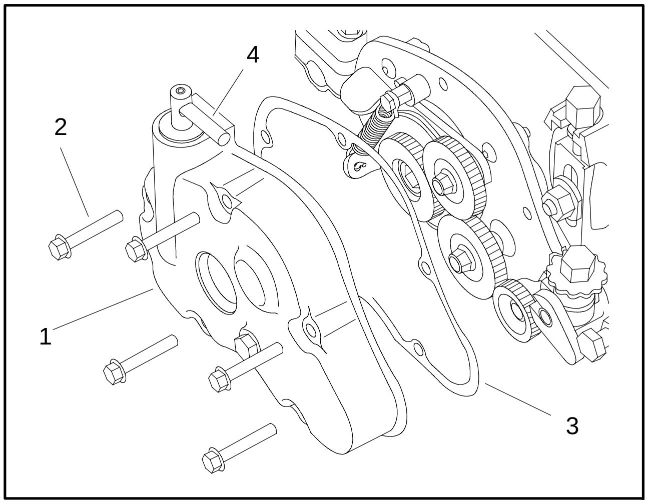

Figure 28

1. **Groomer cover assembly**
2. **Screw (5 used)**
3. **Gasket**
4. **Handle**

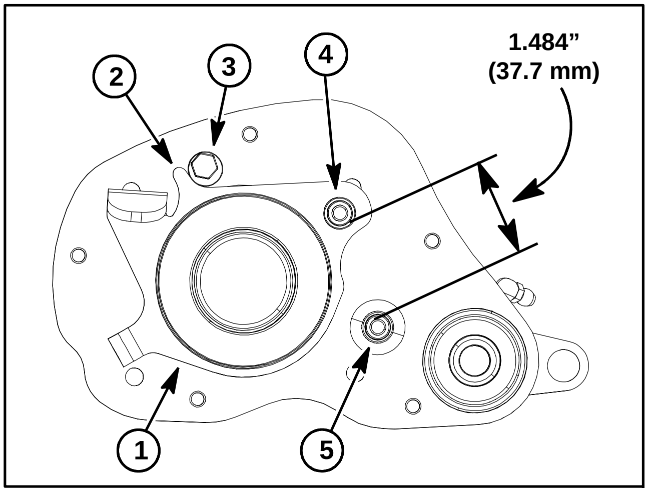

Figure 29

1. **Idler bracket**
2. **Idler bracket stop**
3. **Adjustment cam**
4. **Idler bracket location**
5. **Plate bearing location**

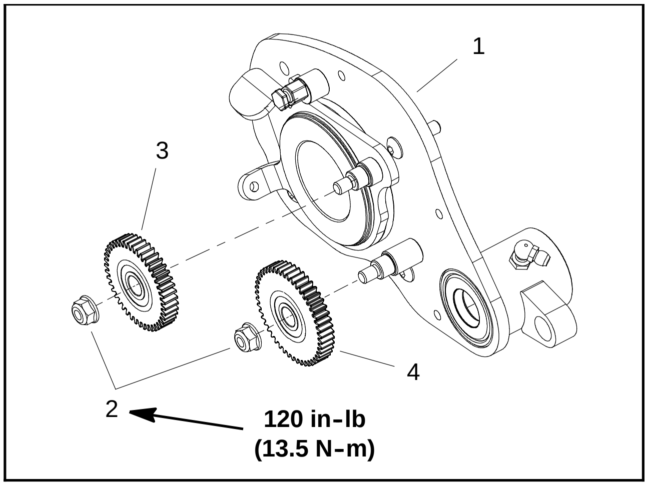

Figure 30

1. **RH drive plate assy**
2. **Flange nut**
3. **43T idler gear/bearing**
4. **47T idler gear/bearing**

Lift Arm Assembly

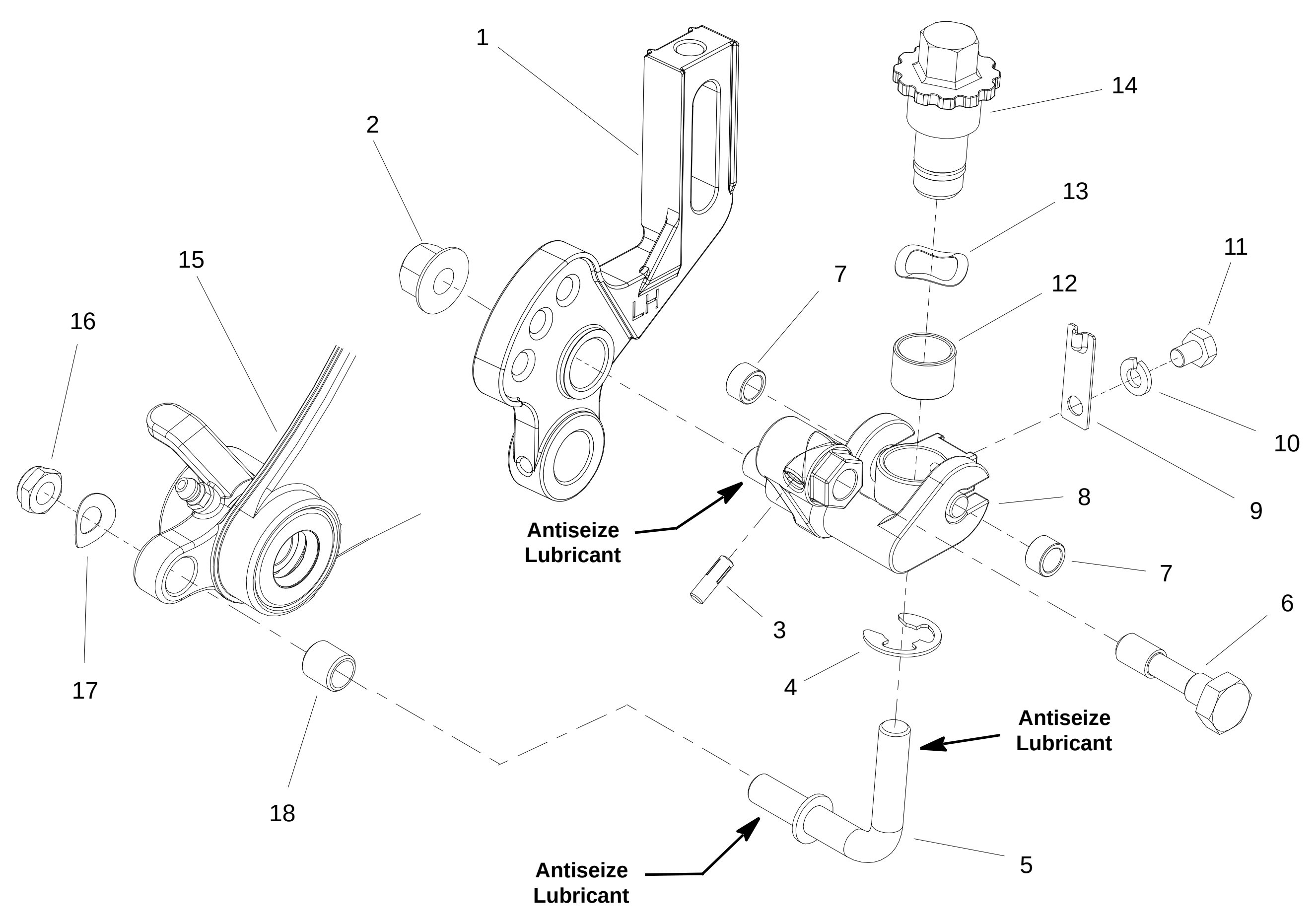
1
14
2
13
15
11
7
12
16
10
8
Antiseize Lubricant
9
7
6
3
4
17
Antiseize Lubricant
18
5
Antiseize Lubricant

Figure 31

1. **HOC groomer arm (LH shown)**
2. **Flange nut**
3. **Grooved pin**
4. **E-ring**
5. **Groomer lift rod**
6. **Lock screw**
7. **Bushing**
8. **Lift arm assembly (LH shown)**
9. **Detent spring**
10. **Spring washer**
11. **Cap screw**
12. **Bushing**
13. **Wave washer**
14. **Groomer adjuster**
15. **Side plate (LH shown)**
16. **Lock nut**
17. **Spring washer**
18. **Bushing**

Disassembly (Fig. 31)

1. Park machine on a clean, level surface. Lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Disconnect the cutting units from the electrical power supply by separating the cutting unit power disconnect couplers (see Opening Electrical Circuit to Cutting Units in the General Information section of this chapter). This will prevent unexpected cutting unit operation.

3. Remove flange nut (item 2) that secures lift arm assembly to HOC groomer arm. Remove lock nut (item 16) and spring washer (item 17) that secure lift arm assembly to side plate. Loosen lock screw (item 6) completely.

4. Remove lift arm assembly from cutting unit.

5. Disassemble lift arm using Figure 31 as a guide.

NOTE: Right and left side HOC groomer arms (item 1) and lift arm assemblies (item 8) are different; other components shown in Figure 31 are the same on both sides of cutting unit.

NOTE: Grooved pin (item 3) is used to retain lock screw (item 6) to lift arm assembly.

Assembly (Fig. 31)

1. Assemble lift arm using Figure 31 as a guide.

2. Apply antiseize lubricant to threads of groomer lift rod (item 5) and lift arm assembly stud (item 8).

3. Install lift arm assembly onto cutting unit. Secure with flange nut (item 2) and lock nut (item 16) with spring washer (item 17).

4. Secure groomer in raised or lowered position with lock screw (item 6).

5. Check and adjust grooming reel height and mower height-of-cut settings.

6. Connect the cutting unit power disconnect couplers.

Groomer Brush

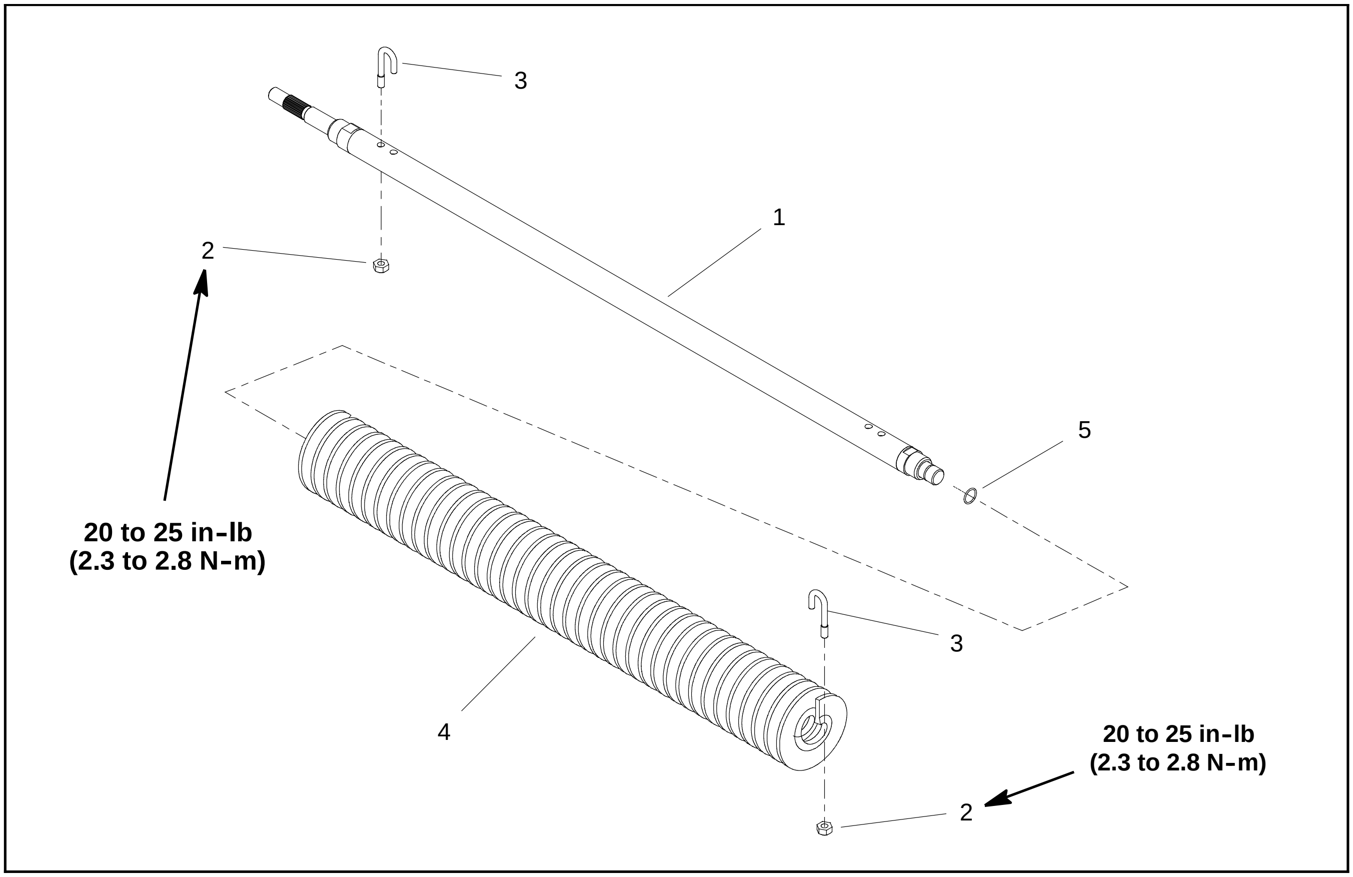

Figure 32

1. **Groomer brush shaft**
2. **Lock nut**
3. **J-bolt**
4. **Groomer brush**
5. **O-ring**

The groomer brush attaches to the groomer drive in place of the grooming reel. Removal and installation of the groomer brush uses the same procedure as removal and installation of the grooming reel (see Grooming Reel in this section).

To remove the groomer brush from the shaft, remove the lock nut and J-bolt from both ends of the brush and slide the brush from the shaft. When assembling the brush to the shaft, secure the assembly with J-bolts and lock nuts. Make sure that the J-bolts are installed with the threaded portion on the outside of the brush (Fig. 33). Torque lock nuts from **20 to 25 in-lb (2.3 to 2.8 N-m)**.

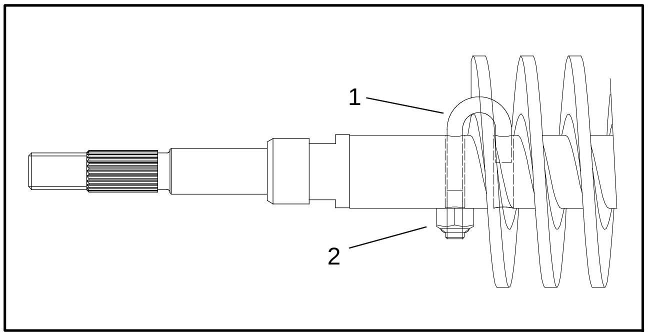

Figure 33

1. **J-bolt**
2. **Lock nut**

Chapter 10

Foldout Drawings

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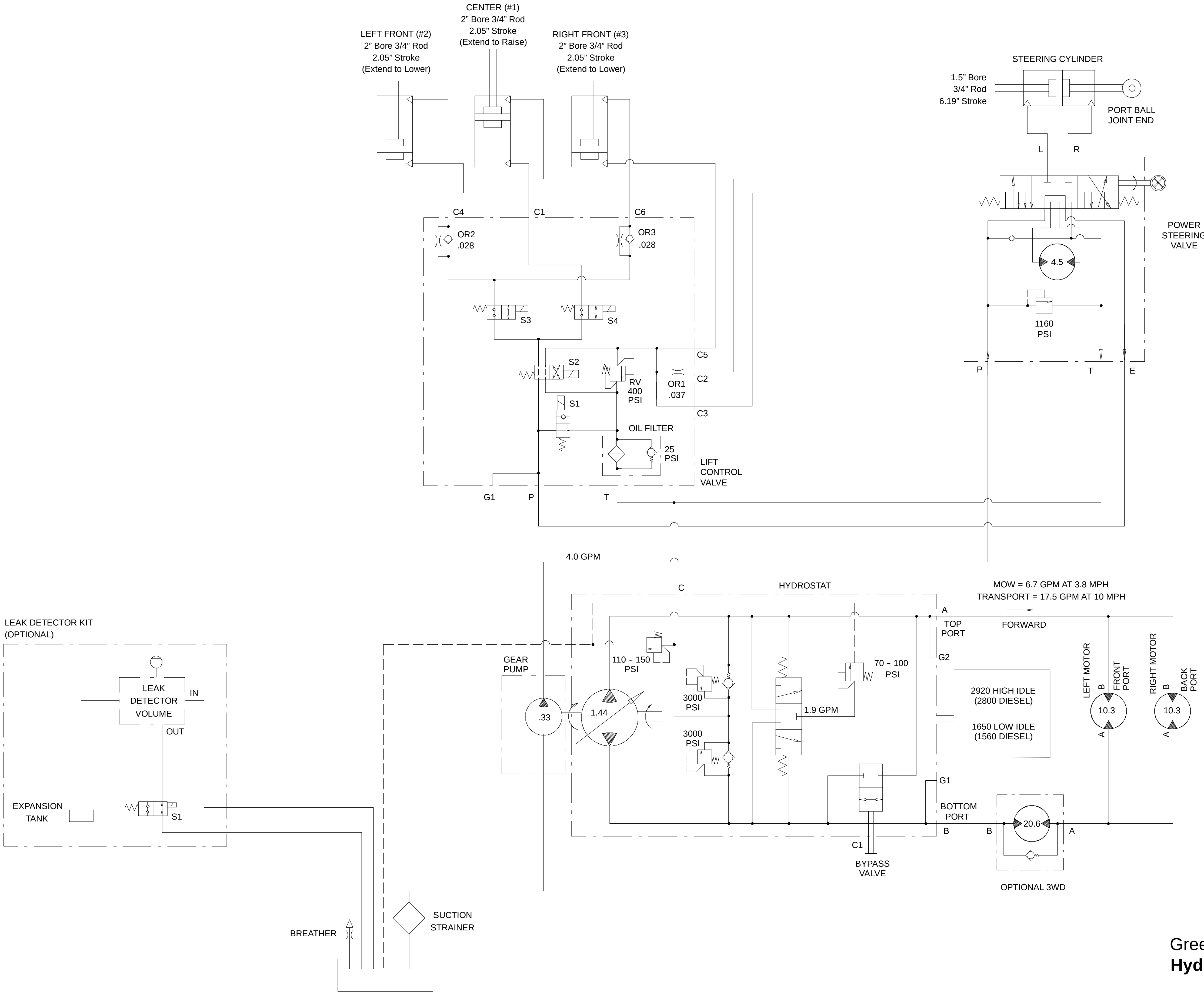
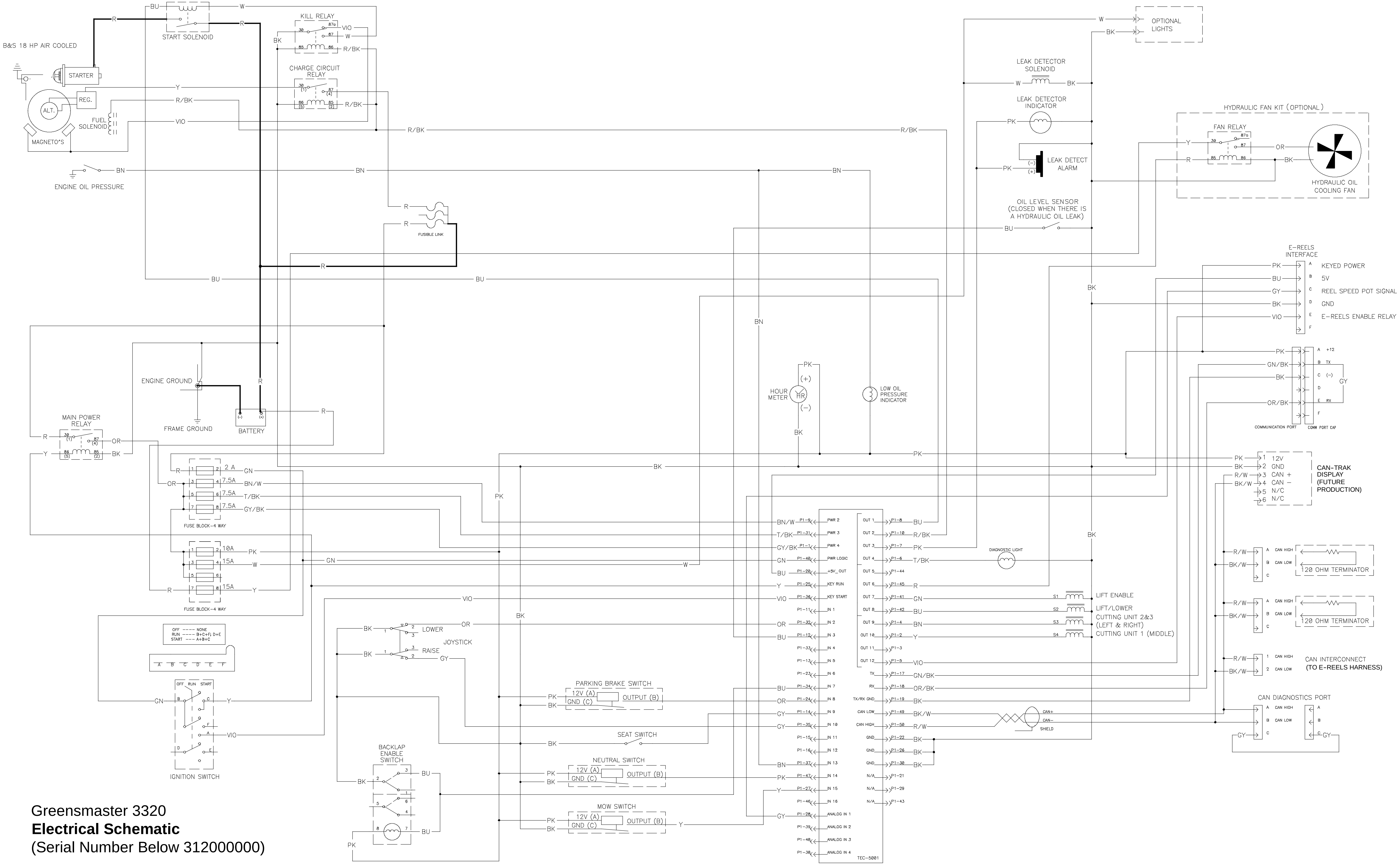

CENTER (#1)
2" Bore 3/4" Rod
2.05" Stroke
(Extend to Raise)
LEFT FRONT (#2)
2" Bore 3/4" Rod
2.05" Stroke
(Extend to Lower)
RIGHT FRONT (#3)
2" Bore 3/4" Rod
2.05" Stroke
(Extend to Lower)
STEERING CYLINDER
1.5" Bore
3/4" Rod
6.19" Stroke
PORT BALL JOINT END
L
R
4.5
1160 PSI
POWER STEERING VALVE
P
T
E
C4
C1
C6
OR2 .028
OR3 .028
S3
S4
S2
RV 400 PSI
OR1 .037
C5
C2
C3
S1
OIL FILTER
25 PSI
LIFT CONTROL VALVE
G1
P
T
4.0 GPM
C
HYDROSTAT
MOW = 6.7 GPM AT 3.8 MPH
TRANSPORT = 17.5 GPM AT 10 MPH
A
TOP PORT
FORWARD
G2
GEAR PUMP
110 – 150 PSI
3000 PSI
3000 PSI
70 – 100 PSI
1.9 GPM
.33
1.44
2920 HIGH IDLE (2800 DIESEL)
1650 LOW IDLE (1560 DIESEL)
LEFT MOTOR
B
FRONT PORT
10.3
A
RIGHT MOTOR
B
BACK PORT
10.3
A
G1
BOTTOM PORT
B
B
20.6
A
C1
BYPASS VALVE
OPTIONAL 3WD
LEAK DETECTOR KIT (OPTIONAL)
LEAK DETECTOR VOLUME
IN
OUT
EXPANSION TANK
S1
BREATHER
SUCTION STRAINER

Greensmaster 3320/3420

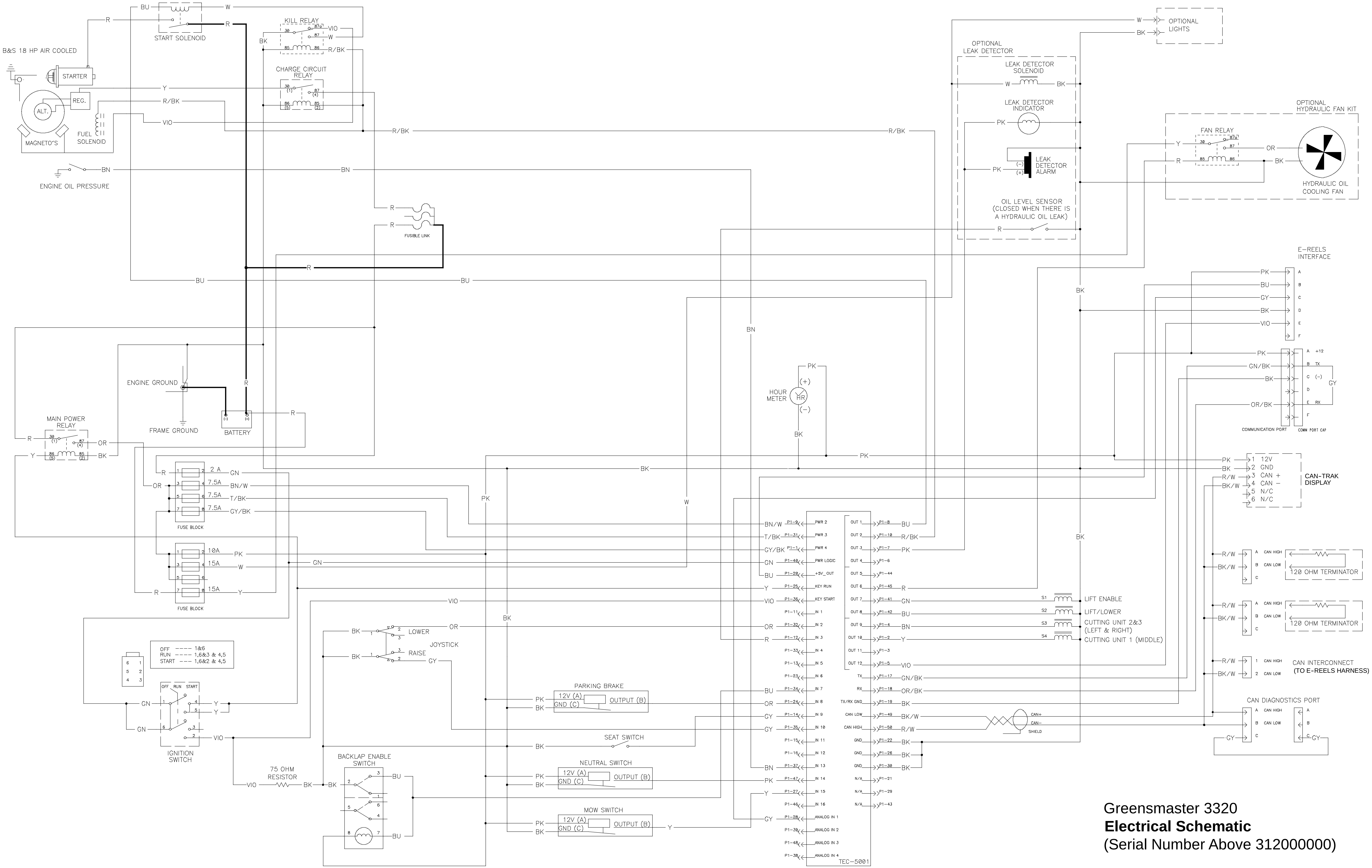
Hydraulic Schematic


B&S 18 HP AIR COOLED
STARTER
REG.
ALT.
FUEL SOLENOID
MAGNETO'S
ENGINE OIL PRESSURE
START SOLENOID
KILL RELAY
CHARGE CIRCUIT RELAY
FUSIBLE LINK
ENGINE GROUND
FRAME GROUND
BATTERY
MAIN POWER RELAY
FUSE BLOCK-4 WAY
2 A
7.5A
7.5A
7.5A
10A
15A
15A
OFF ---- NONE
RUN ---- B+C+F; D+E
START ---- A+B+C
IGNITION SWITCH
LOWER
RAISE
JOYSTICK
BACKLAP ENABLE SWITCH
PARKING BRAKE SWITCH
12V (A)
GND (C)
OUTPUT (B)
SEAT SWITCH
NEUTRAL SWITCH
MOW SWITCH
HOUR METER
LOW OIL PRESSURE INDICATOR
TEC-5001
DIAGNOSTIC LIGHT
LIFT ENABLE
LIFT/LOWER CUTTING UNIT 2&3 (LEFT & RIGHT)
CUTTING UNIT 1 (MIDDLE)
OPTIONAL LIGHTS
LEAK DETECTOR SOLENOID
LEAK DETECTOR INDICATOR
LEAK DETECT ALARM
OIL LEVEL SENSOR (CLOSED WHEN THERE IS A HYDRAULIC OIL LEAK)
HYDRAULIC FAN KIT (OPTIONAL)
FAN RELAY
HYDRAULIC OIL COOLING FAN
E-REELS INTERFACE
KEYED POWER
5V
REEL SPEED POT SIGNAL
GND
E-REELS ENABLE RELAY
COMMUNICATION PORT
COMM PORT CAP
CAN-TRAK DISPLAY (FUTURE PRODUCTION)
12V
GND
CAN +
CAN −
N/C
N/C
120 OHM TERMINATOR
120 OHM TERMINATOR
CAN INTERCONNECT (TO E-REELS HARNESS)
CAN DIAGNOSTICS PORT

Greensmaster 3320

Electrical Schematic

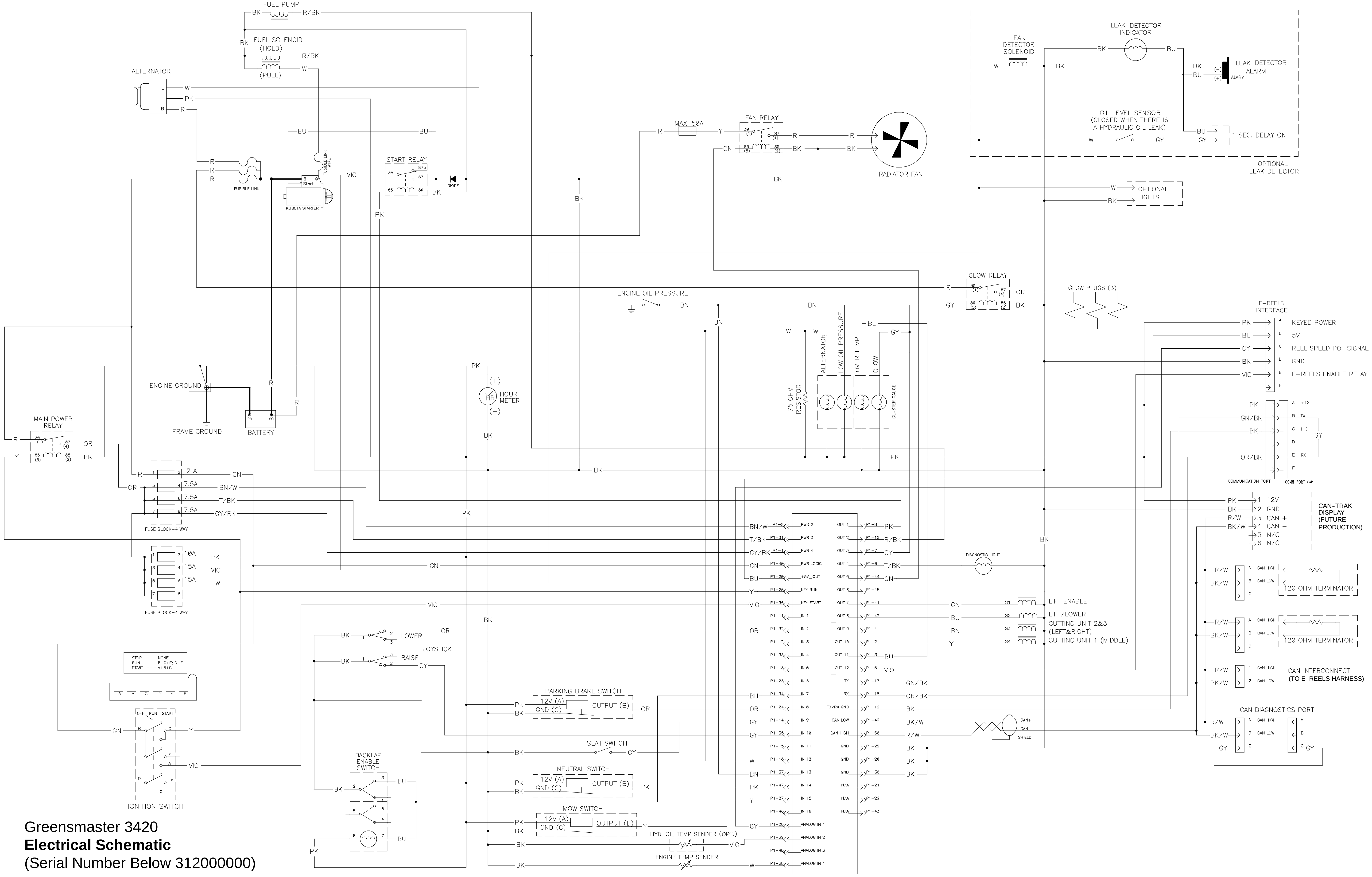
(Serial Number Below 312000000)


B&S 18 HP AIR COOLED
STARTER
START SOLENOID
KILL RELAY
CHARGE CIRCUIT RELAY
ALT.
REG.
MAGNETO'S
FUEL SOLENOID
ENGINE OIL PRESSURE
FUSIBLE LINK
ENGINE GROUND
FRAME GROUND
BATTERY
MAIN POWER RELAY
FUSE BLOCK
2 A
7.5A
7.5A
7.5A
10A
15A
15A
OFF ---- 1&6
RUN ---- 1,6&3 & 4,5
START --- 1,6&2 & 4,5
OFF RUN START
IGNITION SWITCH
LOWER
RAISE
JOYSTICK
75 OHM RESISTOR
BACKLAP ENABLE SWITCH
PARKING BRAKE
12V (A)
GND (C)
OUTPUT (B)
SEAT SWITCH
NEUTRAL SWITCH
MOW SWITCH
HOUR METER
(+)
HR
(-)
TEC-5001
PWR 2
PWR 3
PWR 4
PWR LOGIC
+5V_OUT
KEY RUN
KEY START
IN 1
IN 2
IN 3
IN 4
IN 5
IN 6
IN 7
IN 8
IN 9
IN 10
IN 11
IN 12
IN 13
IN 14
IN 15
IN 16
ANALOG IN 1
ANALOG IN 2
ANALOG IN 3
ANALOG IN 4
OUT 1
OUT 2
OUT 3
OUT 4
OUT 5
OUT 6
OUT 7
OUT 8
OUT 9
OUT 10
OUT 11
OUT 12
TX
RX
TX/RX GND
CAN LOW
CAN HIGH
GND
N/A
S1 LIFT ENABLE
S2 LIFT/LOWER
S3 CUTTING UNIT 2&3 (LEFT & RIGHT)
S4 CUTTING UNIT 1 (MIDDLE)
CAN+
CAN-
SHIELD
OPTIONAL LIGHTS
OPTIONAL LEAK DETECTOR
LEAK DETECTOR SOLENOID
LEAK DETECTOR INDICATOR
LEAK DETECTOR ALARM
OIL LEVEL SENSOR (CLOSED WHEN THERE IS A HYDRAULIC OIL LEAK)
OPTIONAL HYDRAULIC FAN KIT
FAN RELAY
HYDRAULIC OIL COOLING FAN
E-REELS INTERFACE
COMMUNICATION PORT
COMM PORT CAP
A +12
B TX
C (-)
D
E RX
F
1 12V
2 GND
3 CAN +
4 CAN -
5 N/C
6 N/C
CAN-TRAK DISPLAY
CAN HIGH
CAN LOW
120 OHM TERMINATOR
120 OHM TERMINATOR
CAN INTERCONNECT (TO E-REELS HARNESS)
CAN DIAGNOSTICS PORT

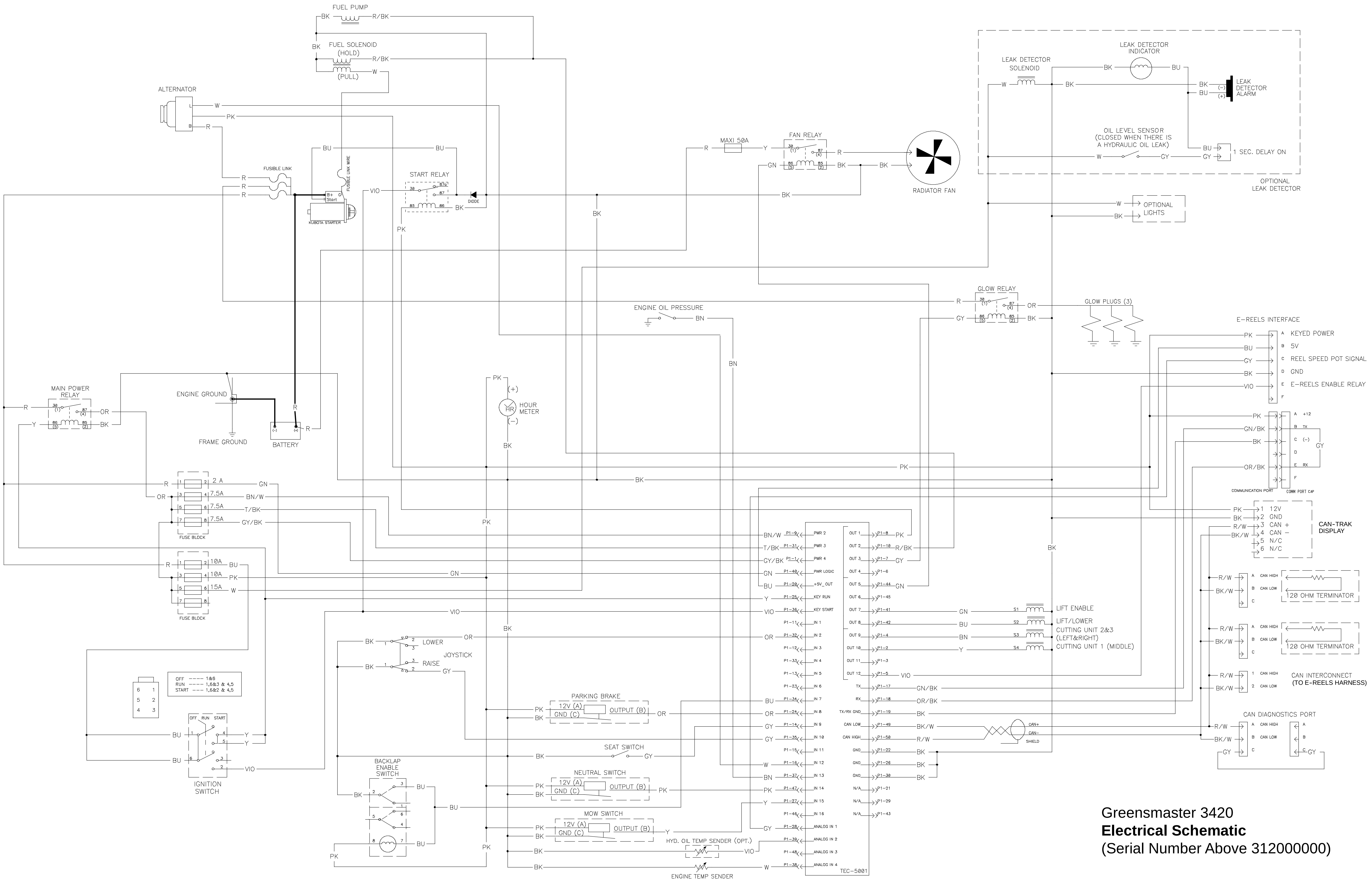
Greensmaster 3320

Electrical Schematic

(Serial Number Above 312000000)


FUEL PUMP
FUEL SOLENOID (HOLD) (PULL)
ALTERNATOR
FUSIBLE LINK
KUBOTA STARTER
FUSIBLE LINK WIRE
START RELAY
DIODE
MAXI 50A
FAN RELAY
RADIATOR FAN
LEAK DETECTOR SOLENOID
LEAK DETECTOR INDICATOR
LEAK DETECTOR ALARM
OIL LEVEL SENSOR (CLOSED WHEN THERE IS A HYDRAULIC OIL LEAK)
1 SEC. DELAY ON
OPTIONAL LEAK DETECTOR
OPTIONAL LIGHTS
GLOW RELAY
GLOW PLUGS (3)
ENGINE OIL PRESSURE
ALTERNATOR
LOW OIL PRESSURE
OVER TEMP.
GLOW
75 OHM RESISTOR
CLUSTER GAUGE
E-REELS INTERFACE
KEYED POWER
5V
REEL SPEED POT SIGNAL
GND
E-REELS ENABLE RELAY
COMMUNICATION PORT
COMM PORT CAP
CAN-TRAK DISPLAY (FUTURE PRODUCTION)
12V
GND
CAN +
CAN -
N/C
ENGINE GROUND
FRAME GROUND
BATTERY
HOUR METER
MAIN POWER RELAY
FUSE BLOCK-4 WAY
2 A
7.5A
10A
15A
DIAGNOSTIC LIGHT
LIFT ENABLE
LIFT/LOWER
CUTTING UNIT 2&3 (LEFT&RIGHT)
CUTTING UNIT 1 (MIDDLE)
120 OHM TERMINATOR
CAN HIGH
CAN LOW
CAN INTERCONNECT (TO E-REELS HARNESS)
CAN DIAGNOSTICS PORT
LOWER
JOYSTICK
RAISE
PARKING BRAKE SWITCH
SEAT SWITCH
NEUTRAL SWITCH
MOW SWITCH
12V (A)
GND (C)
OUTPUT (B)
BACKLAP ENABLE SWITCH
HYD. OIL TEMP SENDER (OPT.)
ENGINE TEMP SENDER
STOP ---- NONE
RUN ---- B+C+F; D+E
START --- A+B+C
OFF RUN START
IGNITION SWITCH
PWR 2
PWR 3
PWR 4
PWR LOGIC
+5V_OUT
KEY RUN
KEY START
ANALOG IN 1
ANALOG IN 2
ANALOG IN 3
ANALOG IN 4
OUT 1
OUT 2
OUT 3
OUT 4
OUT 5
OUT 6
OUT 7
OUT 8
OUT 9
OUT 10
OUT 11
OUT 12
TX
RX
TX/RX GND
CAN LOW
CAN HIGH
SHIELD

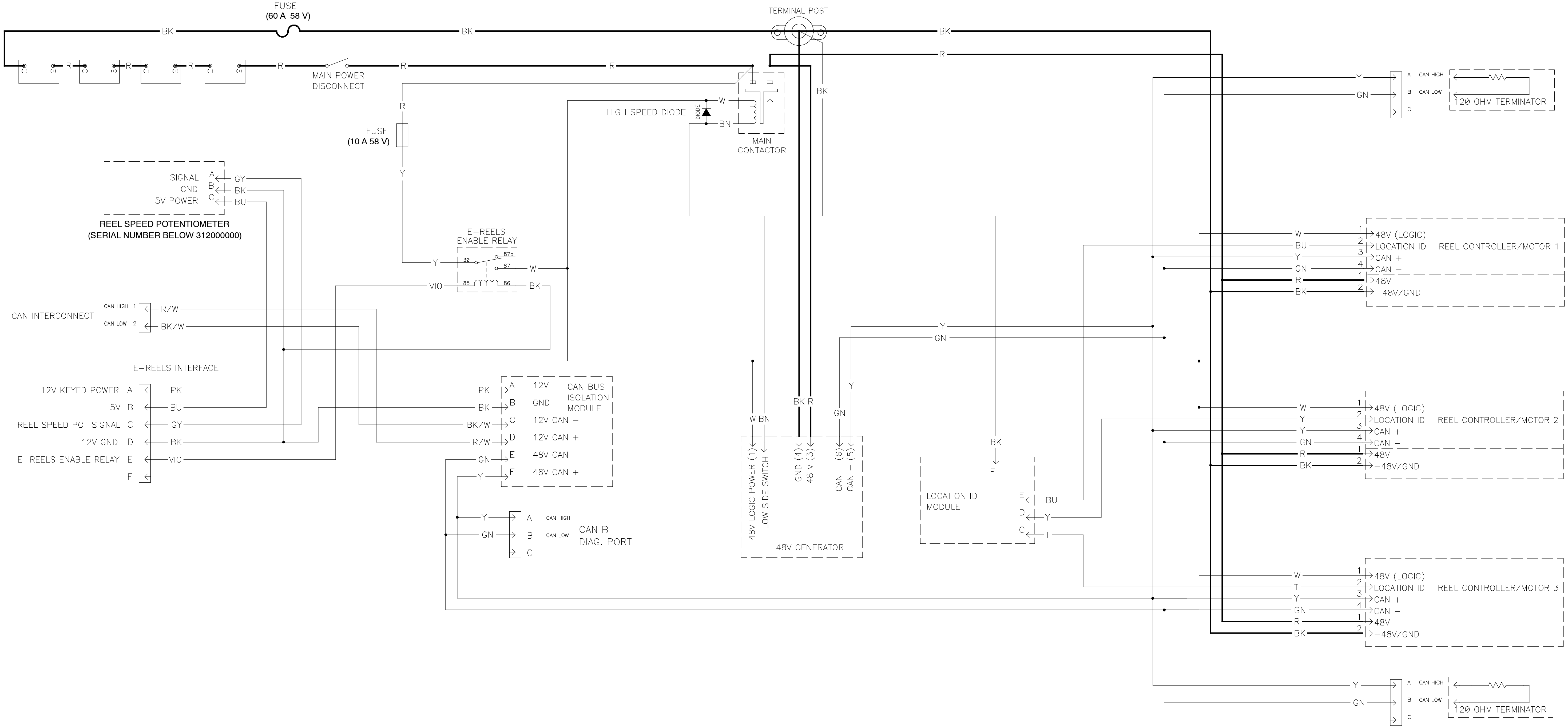
Greensmaster 3420
Electrical Schematic
(Serial Number Below 312000000)


FUEL PUMP
FUEL SOLENOID (HOLD) (PULL)
ALTERNATOR
FUSIBLE LINK
FUSIBLE LINK WIRE
KUBOTA STARTER
B+ Start
START RELAY
DIODE
MAXI 50A
FAN RELAY
RADIATOR FAN
LEAK DETECTOR INDICATOR
LEAK DETECTOR SOLENOID
LEAK DETECTOR ALARM
OIL LEVEL SENSOR (CLOSED WHEN THERE IS A HYDRAULIC OIL LEAK)
1 SEC. DELAY ON
OPTIONAL LEAK DETECTOR
OPTIONAL LIGHTS
GLOW RELAY
GLOW PLUGS (3)
ENGINE OIL PRESSURE
E-REELS INTERFACE
A KEYED POWER
B 5V
C REEL SPEED POT SIGNAL
D GND
E E-REELS ENABLE RELAY
F
MAIN POWER RELAY
ENGINE GROUND
FRAME GROUND
BATTERY
HOUR METER
HR
COMMUNICATION PORT
COMM PORT CAP
A +12
B TX
C (-)
E RX
CAN-TRAK DISPLAY
1 12V
2 GND
3 CAN +
4 CAN −
5 N/C
6 N/C
FUSE BLOCK
2 A
7.5A
7.5A
7.5A
10A
10A
15A
TEC-5001
LIFT ENABLE
LIFT/LOWER
CUTTING UNIT 2&3 (LEFT&RIGHT)
CUTTING UNIT 1 (MIDDLE)
120 OHM TERMINATOR
120 OHM TERMINATOR
CAN HIGH
CAN LOW
CAN INTERCONNECT (TO E-REELS HARNESS)
CAN DIAGNOSTICS PORT
CAN+
CAN−
SHIELD
JOYSTICK
LOWER
RAISE
OFF ---- 1&6
RUN ---- 1,6&3 & 4,5
START ---- 1,6&2 & 4,5
IGNITION SWITCH
OFF RUN START
PARKING BRAKE
12V (A)
GND (C)
OUTPUT (B)
SEAT SWITCH
NEUTRAL SWITCH
MOW SWITCH
BACKLAP ENABLE SWITCH
HYD. OIL TEMP SENDER (OPT.)
ENGINE TEMP SENDER

Greensmaster 3420

Electrical Schematic

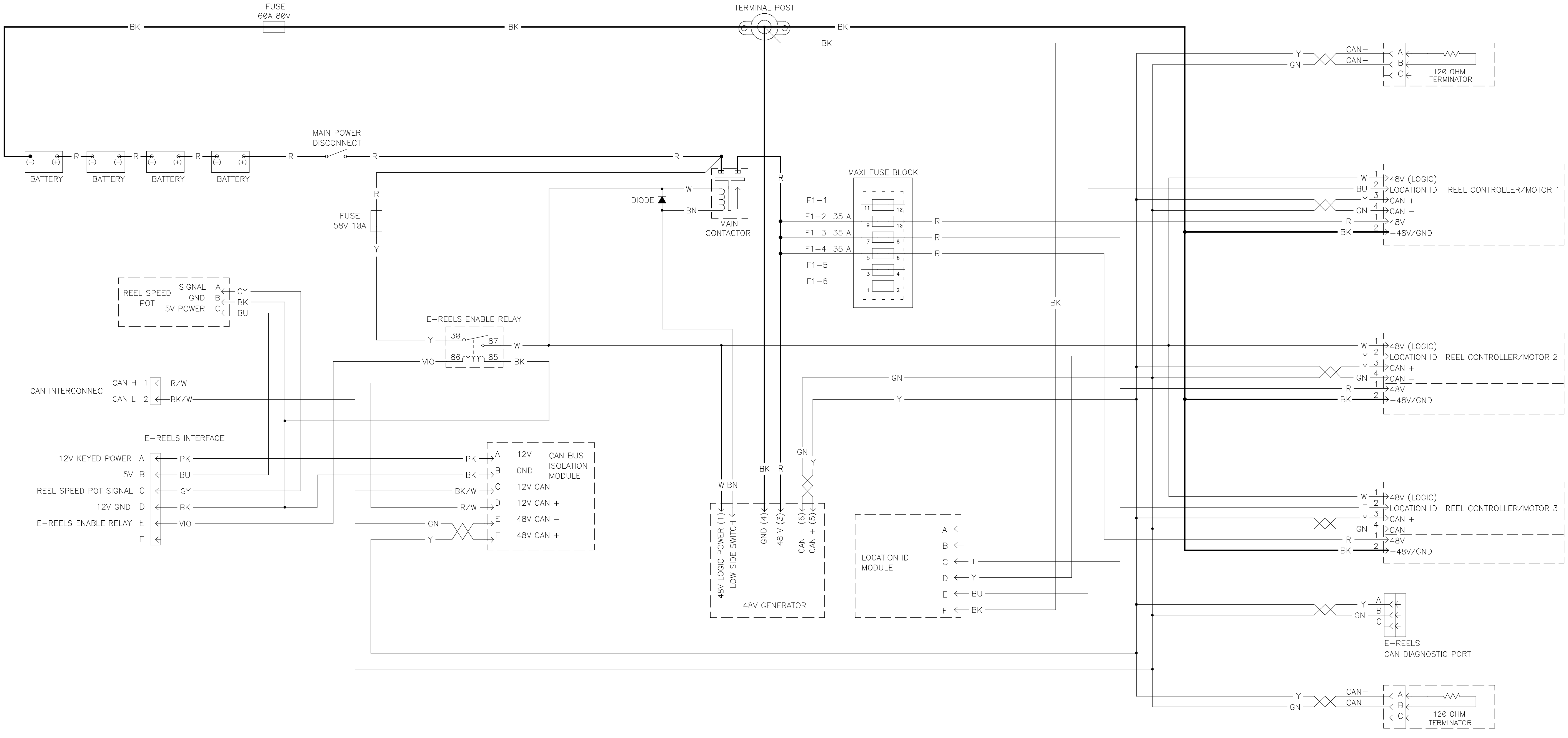
(Serial Number Above 312000000)


FUSE
(60 A 58 V)
BK
TERMINAL POST
R
MAIN POWER DISCONNECT
FUSE
(10 A 58 V)
Y
HIGH SPEED DIODE
DIODE
W
BN
MAIN CONTACTOR
SIGNAL A GY
GND B BK
5V POWER C BU
REEL SPEED POTENTIOMETER
(SERIAL NUMBER BELOW 312000000)
E-REELS ENABLE RELAY
30
87a
87
85
86
VIO
CAN INTERCONNECT
CAN HIGH 1 R/W
CAN LOW 2 BK/W
E-REELS INTERFACE
12V KEYED POWER A PK
5V B BU
REEL SPEED POT SIGNAL C GY
12V GND D BK
E-REELS ENABLE RELAY E VIO
F
CAN BUS ISOLATION MODULE
A 12V
B GND
C 12V CAN −
D 12V CAN +
E 48V CAN −
F 48V CAN +
PK
BK/W
R/W
GN
CAN B DIAG. PORT
A CAN HIGH
B CAN LOW
C
W BN
BK R
48V LOGIC POWER (1)
LOW SIDE SWITCH
GND (4)
48 V (3)
CAN − (6)
CAN + (5)
48V GENERATOR
LOCATION ID MODULE
F
E BU
D Y
C T
120 OHM TERMINATOR
REEL CONTROLLER/MOTOR 1
REEL CONTROLLER/MOTOR 2
REEL CONTROLLER/MOTOR 3
1 48V (LOGIC)
2 LOCATION ID
3 CAN +
4 CAN −
1 48V
2 −48V/GND

Greensmaster 3320/3420

E- Reels Electrical Schematic

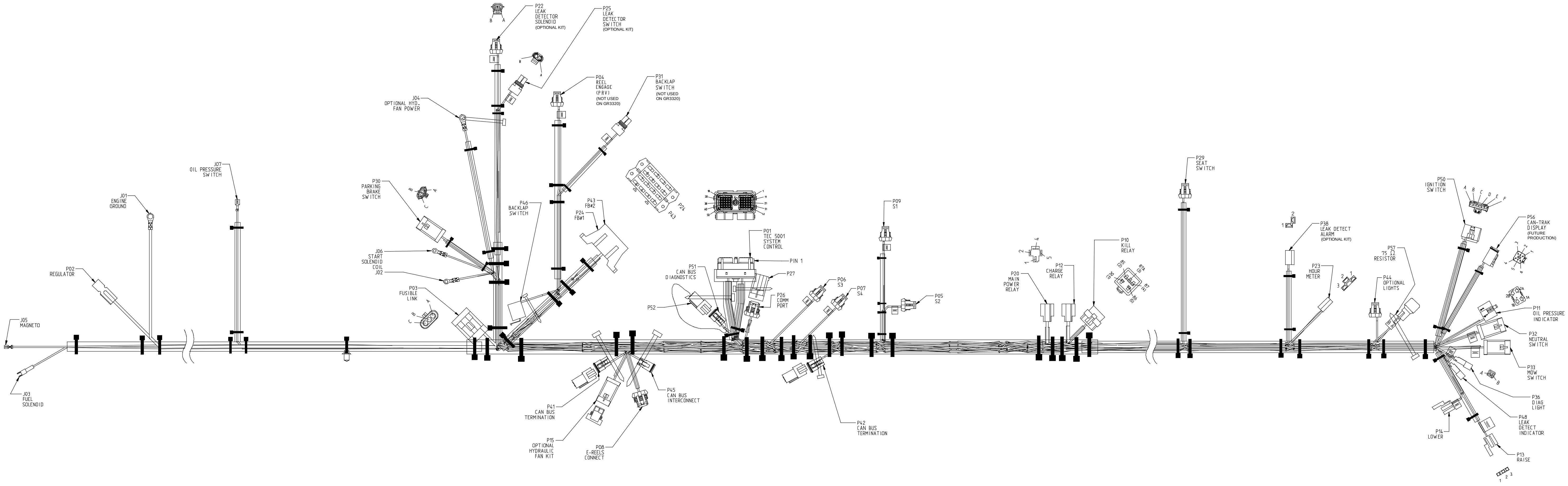
(Serial Number Below 315000000)


FUSE 60A 80V
BK
TERMINAL POST
BATTERY
BATTERY
BATTERY
BATTERY
MAIN POWER DISCONNECT
R
DIODE
W
BN
MAIN CONTACTOR
FUSE 58V 10A
Y
MAXI FUSE BLOCK
F1-1
F1-2 35 A
F1-3 35 A
F1-4 35 A
F1-5
F1-6
REEL SPEED POT
SIGNAL A GY
GND B BK
5V POWER C BU
E-REELS ENABLE RELAY
30
87
86
85
VIO
CAN INTERCONNECT
CAN H 1 R/W
CAN L 2 BK/W
E-REELS INTERFACE
12V KEYED POWER A PK
5V B BU
REEL SPEED POT SIGNAL C GY
12V GND D BK
E-REELS ENABLE RELAY E VIO
F
CAN BUS ISOLATION MODULE
A 12V
B GND
C 12V CAN −
D 12V CAN +
E 48V CAN −
F 48V CAN +
48V GENERATOR
48V LOGIC POWER (1)
LOW SIDE SWITCH
GND (4)
48 V (3)
CAN − (6)
CAN + (5)
LOCATION ID MODULE
A B C D E F
T Y BU BK
GN
Y
CAN+
CAN−
A B C
120 OHM TERMINATOR
48V (LOGIC)
LOCATION ID
CAN +
CAN −
48V
−48V/GND
REEL CONTROLLER/MOTOR 1
REEL CONTROLLER/MOTOR 2
REEL CONTROLLER/MOTOR 3
E-REELS CAN DIAGNOSTIC PORT
120 OHM TERMINATOR

Greensmaster 3320/3420

E- Reels Electrical Schematic

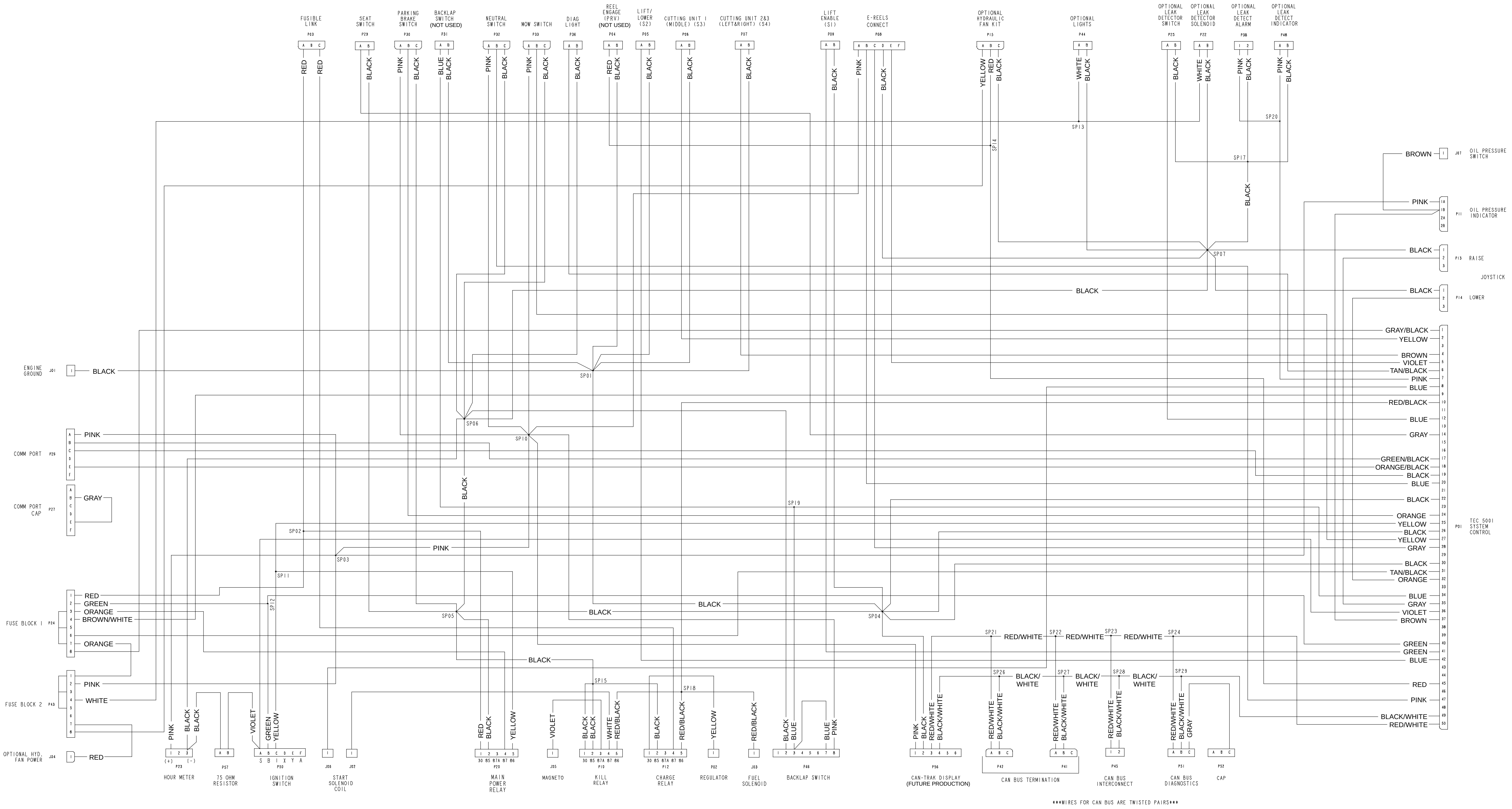
(Serial Number Above 315000000)


J05 MAGNETO
J03 FUEL SOLENOID
P02 REGULATOR
J01 ENGINE GROUND
J07 OIL PRESSURE SWITCH
J04 OPTIONAL HYD. FAN POWER
P30 PARKING BRAKE SWITCH
J06 START SOLENOID COIL
J02
P03 FUSIBLE LINK
P22 LEAK DETECTOR SOLENOID (OPTIONAL KIT)
P25 LEAK DETECTOR SWITCH (OPTIONAL KIT)
P04 REEL ENGAGE (PRV) (NOT USED ON GR3320)
P31 BACKLAP SWITCH (NOT USED ON GR3320)
P46 BACKLAP SWITCH
P43 FB#2
P24 FB#1
P24
P43
P41 CAN BUS TERMINATION
P15 OPTIONAL HYDRAULIC FAN KIT
P08 E-REELS CONNECT
P45 CAN BUS INTERCONNECT
P01 TEC 5001 SYSTEM CONTROL
PIN 1
P51 CAN BUS DIAGNOSTICS
P52
P27
P26 COMM PORT
P06 S3
P07 S4
P42 CAN BUS TERMINATION
P09 S1
P05 S2
P20 MAIN POWER RELAY
P12 CHARGE RELAY
P10 KILL RELAY
85 (2)
87A (3)
30 (1)
87 (4)
86 (5)
P29 SEAT SWITCH
P38 LEAK DETECT ALARM (OPTIONAL KIT)
P23 HOUR METER
P44 OPTIONAL LIGHTS
P57 75 Ω RESISTOR
P50 IGNITION SWITCH
A B C D E F
P56 CAN-TRAK DISPLAY (FUTURE PRODUCTION)
P11 OIL PRESSURE INDICATOR
2A 2B 1A 1B
P32 NEUTRAL SWITCH
P33 MOW SWITCH
P36 DIAG LIGHT
P48 LEAK DETECT INDICATOR
P14 LOWER
P13 RAISE

Greensmaster 3320

Wire Harness Drawing

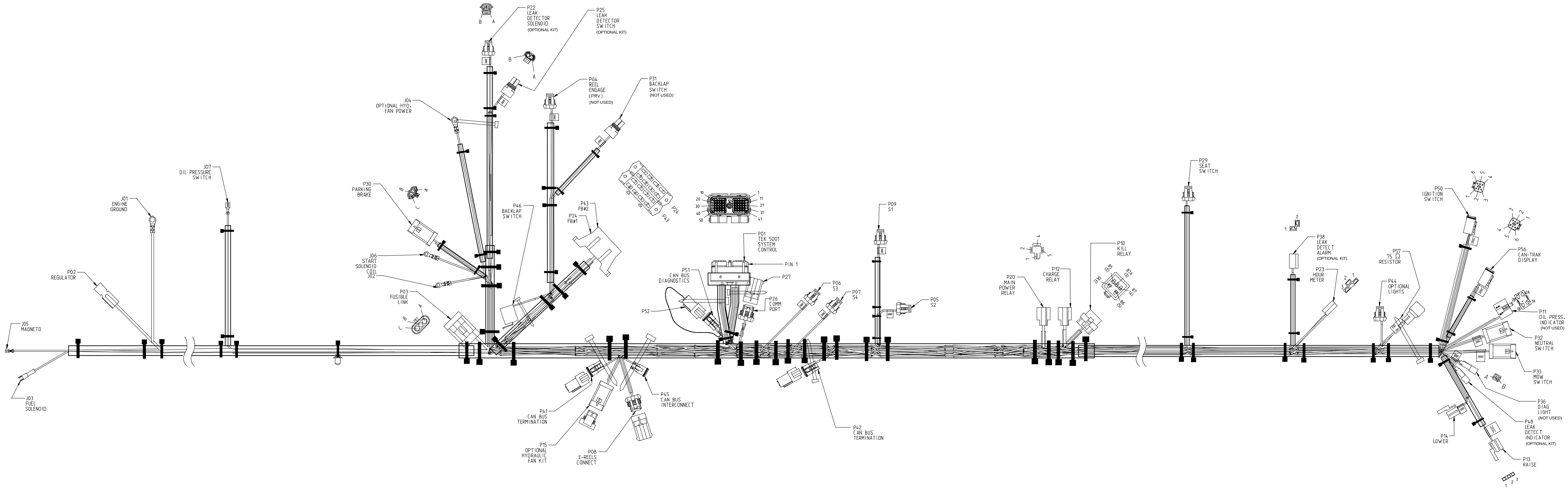
(Serial Number Below 312000000)


FUSIBLE LINK P03
SEAT SWITCH P29
PARKING BRAKE SWITCH P30
BACKLAP SWITCH (NOT USED) P31
NEUTRAL SWITCH P32
MOW SWITCH P33
DIAG LIGHT P36
REEL ENGAGE (PRV) (NOT USED) P04
LIFT/LOWER (S2) P05
CUTTING UNIT 1 (MIDDLE) (S3) P06
CUTTING UNIT 2&3 (LEFT&RIGHT) (S4) P07
LIFT ENABLE (S1) P09
E-REELS CONNECT P28
OPTIONAL HYDRAULIC FAN KIT P15
OPTIONAL LIGHTS P44
OPTIONAL LEAK DETECTOR SWITCH P25
OPTIONAL LEAK DETECTOR SOLENOID P22
OPTIONAL LEAK DETECT ALARM P38
OPTIONAL LEAK DETECT INDICATOR P48
ENGINE GROUND J01
COMM PORT P26
COMM PORT CAP P27
FUSE BLOCK 1 P24
FUSE BLOCK 2 P43
OPTIONAL HYD. FAN POWER J24
OIL PRESSURE SWITCH J07
OIL PRESSURE INDICATOR P11
RAISE P13
JOYSTICK
LOWER P14
TEC 5001 SYSTEM CONTROL P01
HOUR METER P23
75 OHM RESISTOR P57
IGNITION SWITCH P50
START SOLENOID COIL J06 J02
MAIN POWER RELAY P20
MAGNETO J05
KILL RELAY P10
CHARGE RELAY P12
REGULATOR P02
FUEL SOLENOID J03
BACKLAP SWITCH P46
CAN-TRAK DISPLAY (FUTURE PRODUCTION) P56
CAN BUS TERMINATION P42 P41
CAN BUS INTERCONNECT P45
CAN BUS DIAGNOSTICS P51
CAP P52
SP01
SP02
SP03
SP04
SP05
SP06
SP07
SP10
SP11
SP12
SP13
SP14
SP15
SP17
SP18
SP19
SP20
SP21
SP22
SP23
SP24
SP26
SP27
SP28
SP29
RED
BLACK
PINK
BLUE
YELLOW
WHITE
BROWN
GRAY
GREEN
ORANGE
VIOLET
BROWN/WHITE
GRAY/BLACK
TAN/BLACK
RED/BLACK
GREEN/BLACK
ORANGE/BLACK
RED/WHITE
BLACK/WHITE
WIRES FOR CAN BUS ARE TWISTED PAIRS

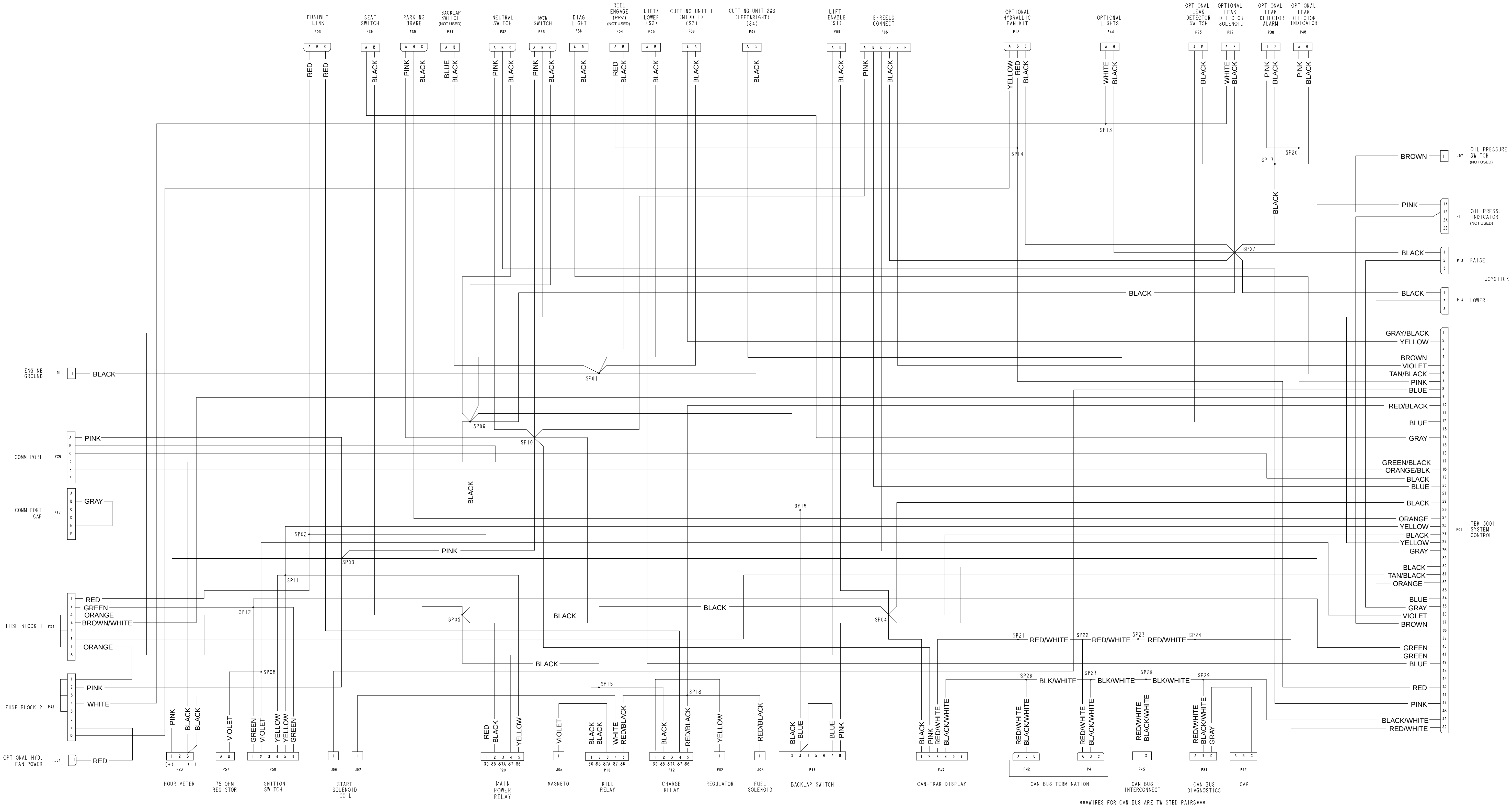
Greensmaster 3320

Wire Harness Diagram

(Serial Number Below 312000000)


P22
LEAK
DETECTOR
SOLENOID
(OPTIONAL KIT)
B A
P25
LEAK
DETECTOR
SWITCH
(OPTIONAL KIT)
B
A
P04
REEL
ENGAGE
(PRV)
(NOT USED)
P31
BACKLAP
SWITCH
(NOT USED)
J04
OPTIONAL HYD.
FAN POWER
J07
OIL PRESSURE
SWITCH
J01
ENGINE
GROUND
P30
PARKING
BRAKE
B A C
P46
BACKLAP
SWITCH
P43
FB#2
P24
FB#1
P24
P43
10
20
30
40
50
1
11
21
31
41
P01
TEK 5001
SYSTEM
CONTROL
PIN 1
P27
P51
CAN BUS
DIAGNOSTICS
P26
COMM
PORT
P52
J06
START
SOLENOID
COIL
J02
P03
FUSIBLE
LINK
A B C
P02
REGULATOR
J05
MAGNETO
J03
FUEL
SOLENOID
P06
S3
P07
S4
P09
S1
P05
S2
P41
CAN BUS
TERMINATION
P45
CAN BUS
INTERCONNECT
P15
OPTIONAL
HYDRAULIC
FAN KIT
P08
E-REELS
CONNECT
P42
CAN BUS
TERMINATION
P20
MAIN
POWER
RELAY
P12
CHARGE
RELAY
4 2 5 1
P10
KILL
RELAY
85 (2)
87A (3)
30 (1)
87 (4)
86 (5)
P29
SEAT
SWITCH
2 1
P38
LEAK
DETECT
ALARM
(OPTIONAL KIT)
P23
HOUR
METER
2 1 3
P57
75 Ω
RESISTOR
P44
OPTIONAL
LIGHTS
B A
P50
IGNITION
SWITCH
6 5 4 1 2 3
3 2 1 4 5 6
P56
CAN-TRAK
DISPLAY
2A 2B 1A 1B
P11
OIL PRESS.
INDICATOR
(NOT USED)
P32
NEUTRAL
SWITCH
P33
MOW
SWITCH
A B
P36
DIAG
LIGHT
(NOT USED)
P48
LEAK
DETECT
INDICATOR
(OPTIONAL KIT)
P14
LOWER
P13
RAISE
1 2 3

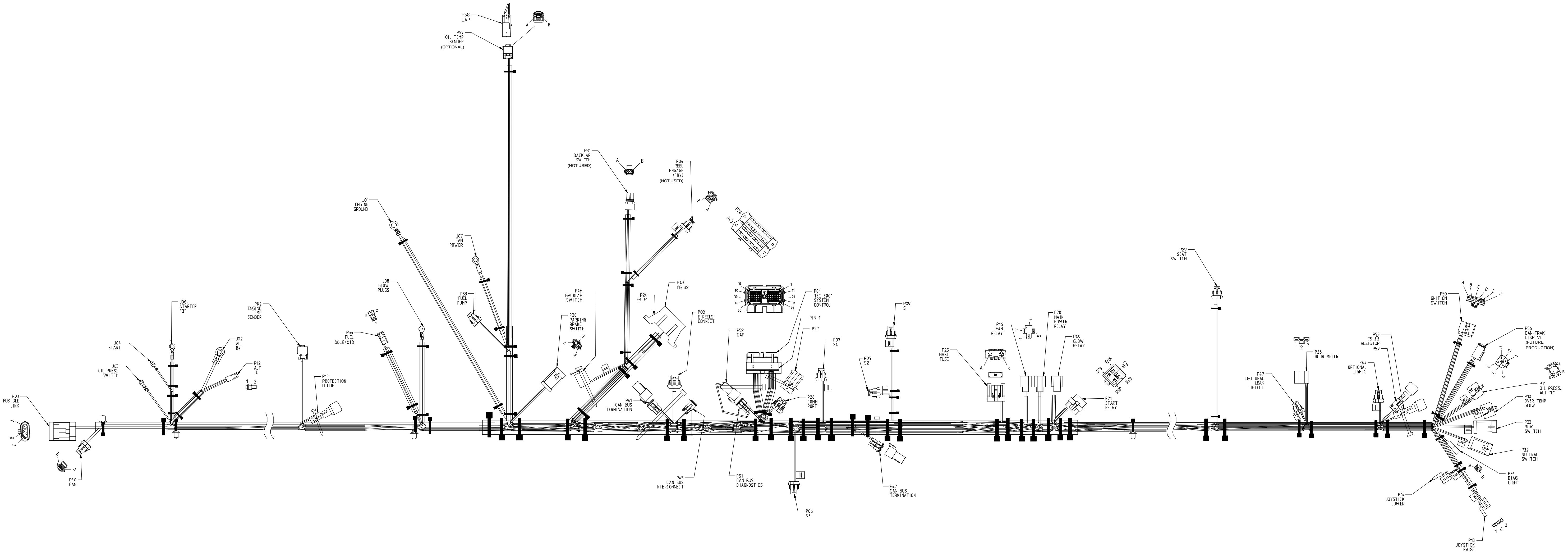
Greensmaster 3320
Wire Harness Drawing
(Serial Number Above 312000000)


FUSIBLE LINK P03
SEAT SWITCH P29
PARKING BRAKE P30
BACKLAP SWITCH (NOT USED) P31
NEUTRAL SWITCH P32
MOW SWITCH P33
DIAG LIGHT P38
REEL ENGAGE (PRV) (NOT USED) P04
LIFT/ LOWER (S2) P05
CUTTING UNIT 1 (MIDDLE) (S3) P06
CUTTING UNIT 2&3 (LEFT&RIGHT) (S4) P07
LIFT ENABLE (S1) P09
E-REELS CONNECT P58
OPTIONAL HYDRAULIC FAN KIT P15
OPTIONAL LIGHTS P44
OPTIONAL LEAK DETECTOR SWITCH P25
OPTIONAL LEAK DETECTOR SOLENOID P22
OPTIONAL LEAK DETECTOR ALARM P36
OPTIONAL LEAK DETECTOR INDICATOR P48
OIL PRESSURE SWITCH (NOT USED) J07
OIL PRESS. INDICATOR (NOT USED) P11
RAISE P13
JOYSTICK
LOWER P14
TEK 5001 SYSTEM CONTROL P01
ENGINE GROUND J01
COMM PORT P26
COMM PORT CAP P27
FUSE BLOCK 1 P24
FUSE BLOCK 2 P43
OPTIONAL HYD. FAN POWER J04
HOUR METER P23
75 OHM RESISTOR P57
IGNITION SWITCH P50
START SOLENOID COIL J06 J02
MAIN POWER RELAY P20
MAGNETO J05
KILL RELAY P10
CHARGE RELAY P12
REGULATOR P02
FUEL SOLENOID J03
BACKLAP SWITCH P46
CAN-TRAK DISPLAY P56
CAN BUS TERMINATION P42 P41
CAN BUS INTERCONNECT P45
CAN BUS DIAGNOSTICS P51
CAP P52
WIRES FOR CAN BUS ARE TWISTED PAIRS
SP01 SP02 SP03 SP04 SP05 SP06 SP07 SP08 SP10 SP11 SP12 SP13 SP14 SP15 SP17 SP18 SP19 SP20 SP21 SP22 SP23 SP24 SP26 SP27 SP28 SP29
RED
GREEN
ORANGE
BROWN/WHITE
PINK
WHITE
BLACK
GRAY
VIOLET
YELLOW
BLUE
RED/BLACK
RED/WHITE
BLK/WHITE
BLACK/WHITE
GRAY/BLACK
TAN/BLACK
GREEN/BLACK
ORANGE/BLK
BROWN

Greensmaster 3320

Wire Harness Diagram

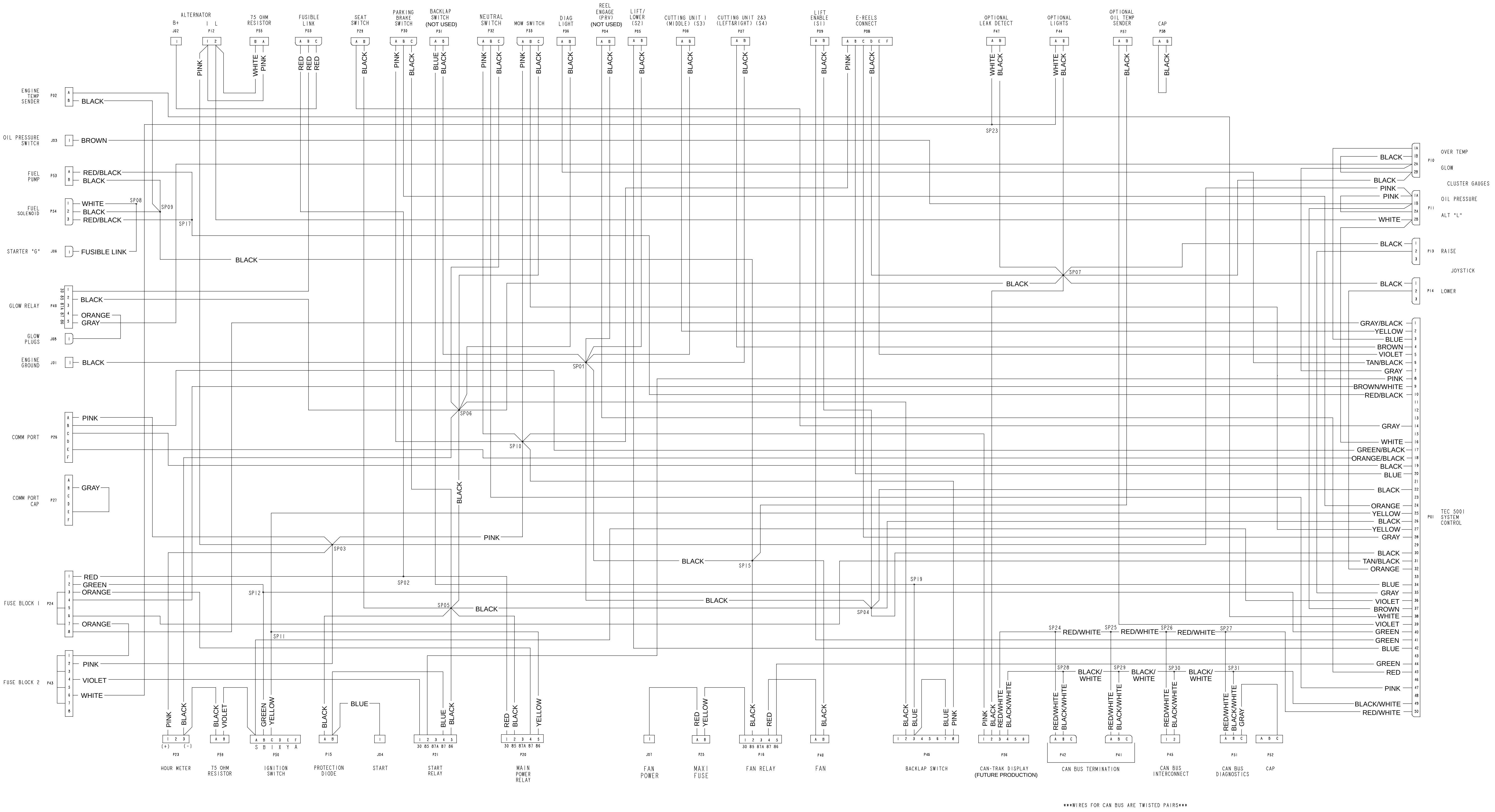
(Serial Number Above 312000000)


P58 CAP
P57 OIL TEMP SENDER (OPTIONAL)
A
B
P31 BACKLAP SWITCH (NOT USED)
A
B
P04 REEL ENGAGE (PRV) (NOT USED)
B
A
P24
P43
J01 ENGINE GROUND
J07 FAN POWER
J08 GLOW PLUGS
P53 FUEL PUMP
P46 BACKLAP SWITCH
P30 PARKING BRAKE SWITCH
C
B
A
P24 FB #1
P43 FB #2
P08 E-REELS CONNECT
10
20
30
40
50
1
11
21
31
41
P01 TEC 5001 SYSTEM CONTROL
PIN 1
P27
P52 CAP
P07 S4
P09 S1
P05 S2
P26 COMM PORT
J06 STARTER "G"
P02 ENGINE TEMP SENDER
J04 START
J02 ALT B+
J03 OIL PRESS SWITCH
P12 ALT IL
1 2
P54 FUEL SOLENOID
3 2 1
P15 PROTECTION DIODE
P03 FUSIBLE LINK
A
B
C
B
A
P40 FAN
P41 CAN BUS TERMINATION
P45 CAN BUS INTERCONNECT
P51 CAN BUS DIAGNOSTICS
P06 S3
P42 CAN BUS TERMINATION
P25 MAXI FUSE
A
B
P16 FAN RELAY
4 2 5 1
P20 MAIN POWER RELAY
P49 GLOW RELAY
30 (1)
85 (2)
87A (3)
87 (4)
86 (5)
P21 START RELAY
P29 SEAT SWITCH
1 3 2
P23 HOUR METER
P47 OPTIONAL LEAK DETECT
P44 OPTIONAL LIGHTS
P55 75 Ω RESISTOR
P59
A B C D E F
P50 IGNITION SWITCH
P56 CAN-TRAK DISPLAY (FUTURE PRODUCTION)
3 2 1 4 5 6
2B 2A 1B 1A
P11 OIL PRESS. ALT "L"
P10 OVER TEMP GLOW
P33 MOW SWITCH
P32 NEUTRAL SWITCH
P36 DIAG LIGHT
A
B
P14 JOYSTICK LOWER
1 2 3
P13 JOYSTICK RAISE

Greensmaster 3420

Wire Harness Drawing

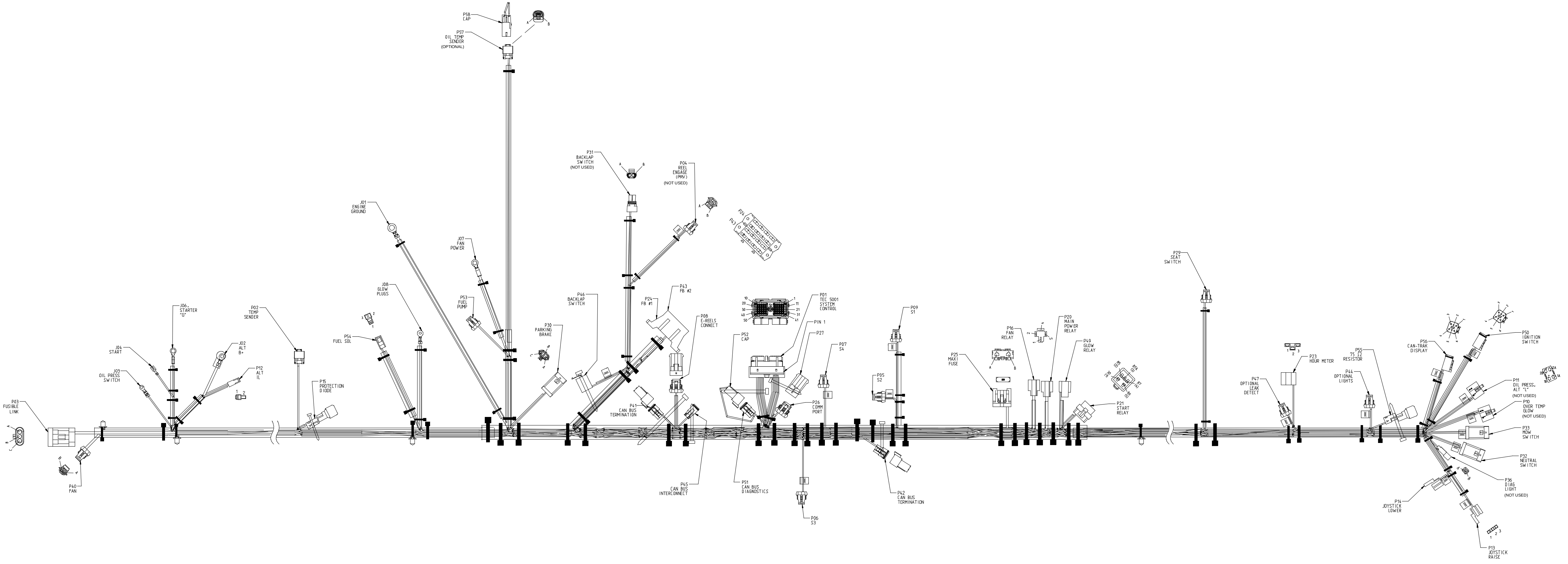
(Serial Number Below 312000000)


ALTERNATOR B+ J02
I L P12
75 OHM RESISTOR P55
FUSIBLE LINK P03
SEAT SWITCH P29
PARKING BRAKE SWITCH P30
BACKLAP SWITCH (NOT USED) P31
NEUTRAL SWITCH P32
MOW SWITCH P33
DIAG LIGHT P36
REEL ENGAGE (PRV) (NOT USED) P04
LIFT/ LOWER (S2) P05
CUTTING UNIT 1 (MIDDLE) (S3) P06
CUTTING UNIT 2&3 (LEFT&RIGHT) (S4) P07
LIFT ENABLE (S1) P09
E-REELS CONNECT P08
OPTIONAL LEAK DETECT P47
OPTIONAL LIGHTS P44
OPTIONAL OIL TEMP SENDER P57
CAP P58
ENGINE TEMP SENDER P02
OIL PRESSURE SWITCH J03
FUEL PUMP P53
FUEL SOLENOID P54
STARTER "G" J04
GLOW RELAY P49
GLOW PLUGS J05
ENGINE GROUND J01
COMM PORT P26
COMM PORT CAP P27
FUSE BLOCK 1 P24
FUSE BLOCK 2 P43
SP01
SP02
SP03
SP04
SP05
SP06
SP07
SP08
SP09
SP10
SP11
SP12
SP15
SP17
SP19
SP23
SP24
SP25
SP26
SP27
SP28
SP29
SP30
SP31
BLACK
BROWN
RED/BLACK
WHITE
FUSIBLE LINK
ORANGE
GRAY
PINK
RED
GREEN
VIOLET
YELLOW
BLUE
RED/WHITE
BLACK/WHITE
OVER TEMP
GLOW
CLUSTER GAUGES
OIL PRESSURE
ALT "L"
P10
P11
RAISE P13
JOYSTICK
LOWER P14
GRAY/BLACK
TAN/BLACK
BROWN/WHITE
GREEN/BLACK
ORANGE/BLACK
TEC 5001 SYSTEM CONTROL P01
HOUR METER P23 (+) (-)
75 OHM RESISTOR P59
IGNITION SWITCH P50 S B I X Y A
PROTECTION DIODE P15
START J04
START RELAY P21 30 85 87A 87 86
MAIN POWER RELAY P20 30 85 87A 87 86
FAN POWER J07
MAXI FUSE P25
FAN RELAY P16 30 85 87A 87 86
FAN P40
BACKLAP SWITCH P48
CAN-TRAK DISPLAY (FUTURE PRODUCTION) P56
CAN BUS TERMINATION P42 P41
CAN BUS INTERCONNECT P45
CAN BUS DIAGNOSTICS P51
CAP P52
WIRES FOR CAN BUS ARE TWISTED PAIRS

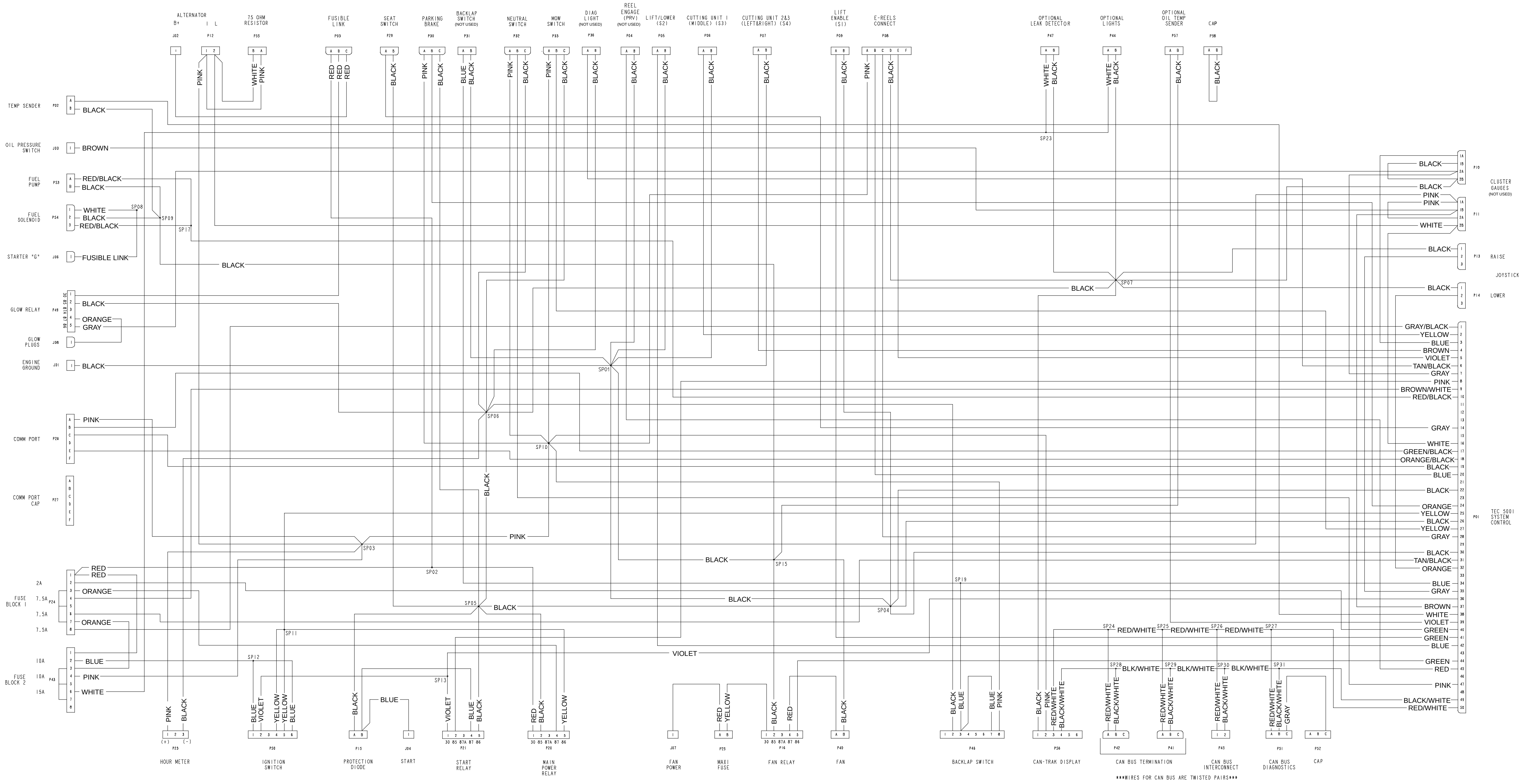
Greensmaster 3420

Wire Harness Diagram

(Serial Number Below 312000000)


P58
CAP
P57
OIL TEMP
SENDER
(OPTIONAL)
A
B
P31
BACKLAP
SWITCH
(NOT USED)
A
B
P04
REEL
ENGAGE
(PRV)
(NOT USED)
A
B
P24
P43
J01
ENGINE
GROUND
J07
FAN
POWER
J08
GLOW
PLUGS
P53
FUEL
PUMP
3
2
1
P54
FUEL SOL
J06.
STARTER
"G"
P02
TEMP
SENDER
J04
START
J02
ALT
B+
P12
ALT
IL
1
2
J03
OIL PRESS
SWITCH
P15
PROTECTION
DIODE
P03
FUSIBLE
LINK
A
B
C
B
A
P40
FAN
P30
PARKING
BRAKE
B
C
A
P46
BACKLAP
SWITCH
P24
FB #1
P43
FB #2
P08
E-REELS
CONNECT
P41
CAN BUS
TERMINATION
P45
CAN BUS
INTERCONNECT
10
20
30
40
50
1
11
21
31
41
P01
TEC 5001
SYSTEM
CONTROL
PIN 1
P27
P52
CAP
P51
CAN BUS
DIAGNOSTICS
P26
COMM
PORT
P07
S4
P06
S3
P09
S1
P05
S2
P42
CAN BUS
TERMINATION
P25
MAXI
FUSE
A
B
P16
FAN
RELAY
4
2
5
1
P20
MAIN
POWER
RELAY
P49
GLOW
RELAY
85
(2)
87A
(3)
30
(1)
87
(4)
86
(5)
P21
START
RELAY
P29
SEAT
SWITCH
1
2
3
P23
HOUR METER
P47
OPTIONAL
LEAK
DETECT
P55
75 Ω
RESISTOR
P44
OPTIONAL
LIGHTS
3
2
1
4
5
6
P56
CAN-TRAK
DISPLAY
3
2
1
4
5
6
P50
IGNITION
SWITCH
2A
2B
1A
1B
P11
OIL PRESS.
ALT "L"
(NOT USED)
P10
OVER TEMP
GLOW
(NOT USED)
P33
MOW
SWITCH
P32
NEUTRAL
SWITCH
A
B
P36
DIAG
LIGHT
(NOT USED)
P14
JOYSTICK
LOWER
1
2
3
P13
JOYSTICK
RAISE

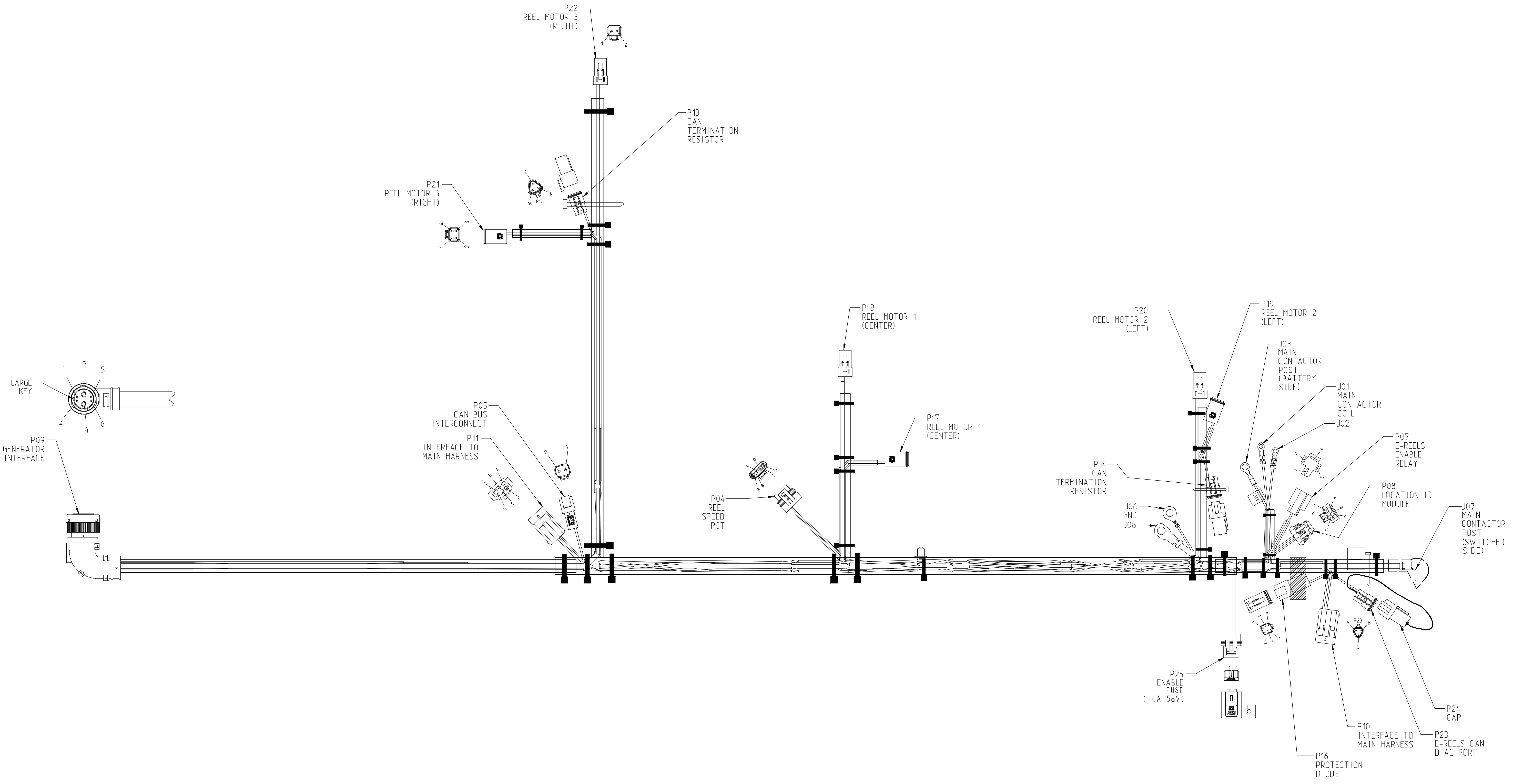
Greensmaster 3420
Wire Harness Drawing
(Serial Number Above 312000000)


ALTERNATOR
B+
I L
J02
P12
75 OHM RESISTOR
P35
FUSIBLE LINK
P03
SEAT SWITCH
P29
PARKING BRAKE
P30
BACKLAP SWITCH (NOT USED)
P31
NEUTRAL SWITCH
P32
MOW SWITCH
P33
DIAG LIGHT (NOT USED)
P36
REEL ENGAGE (PRV) (NOT USED)
P04
LIFT/LOWER (S2)
P05
CUTTING UNIT 1 (MIDDLE) (S3)
P06
CUTTING UNIT 2&3 (LEFT&RIGHT) (S4)
P07
LIFT ENABLE (S1)
P09
E-REELS CONNECT
P38
OPTIONAL LEAK DETECTOR
P47
OPTIONAL LIGHTS
P44
OPTIONAL OIL TEMP SENDER
P57
CAP
P58
TEMP SENDER
P02
OIL PRESSURE SWITCH
J03
FUEL PUMP
P53
FUEL SOLENOID
P54
STARTER "G"
J06
GLOW RELAY
P49
GLOW PLUGS
J08
ENGINE GROUND
J01
COMM PORT
P26
COMM PORT CAP
P27
FUSE BLOCK 1
P24
2A
7.5A
7.5A
7.5A
FUSE BLOCK 2
P43
10A
10A
15A
CLUSTER GAUGES (NOT USED)
P10
P11
RAISE
P13
JOYSTICK
LOWER
P14
TEC 5001 SYSTEM CONTROL
P01
HOUR METER
P23
(+)
(-)
IGNITION SWITCH
P50
PROTECTION DIODE
P15
START
J04
START RELAY
P21
MAIN POWER RELAY
P20
FAN POWER
J07
MAXI FUSE
P25
FAN RELAY
P16
FAN
P40
BACKLAP SWITCH
P46
CAN-TRAK DISPLAY
P56
CAN BUS TERMINATION
P42
P41
CAN BUS INTERCONNECT
P45
CAN BUS DIAGNOSTICS
P51
CAP
P52
WIRES FOR CAN BUS ARE TWISTED PAIRS
SP01
SP02
SP03
SP04
SP05
SP06
SP07
SP08
SP09
SP10
SP11
SP12
SP13
SP15
SP17
SP19
SP23
SP24
SP25
SP26
SP27
SP28
SP29
SP30
SP31
BLACK
BROWN
RED/BLACK
WHITE
FUSIBLE LINK
ORANGE
GRAY
PINK
RED
BLUE
VIOLET
YELLOW
GRAY/BLACK
TAN/BLACK
BROWN/WHITE
GREEN/BLACK
ORANGE/BLACK
GREEN
RED/WHITE
BLK/WHITE
BLACK/WHITE

Greensmaster 3420

Wire Harness Diagram

(Serial Number Above 312000000)


P22
REEL MOTOR 3
(RIGHT)
1
2
P13
CAN
TERMINATION
RESISTOR
P21
REEL MOTOR 3
(RIGHT)
P18
REEL MOTOR 1
(CENTER)
P20
REEL MOTOR 2
(LEFT)
P19
REEL MOTOR 2
(LEFT)
J03
MAIN
CONTACTOR
POST
(BATTERY
SIDE)
J01
MAIN
CONTACTOR
COIL
J02
P07
E-REELS
ENABLE
RELAY
P08
LOCATION ID
MODULE
J07
MAIN
CONTACTOR
POST
(SWITCHED
SIDE)
1
3
5
LARGE
KEY
2
4
6
P09
GENERATOR
INTERFACE
P05
CAN BUS
INTERCONNECT
P11
INTERFACE TO
MAIN HARNESS
P17
REEL MOTOR 1
(CENTER)
P04
REEL
SPEED
POT
P14
CAN
TERMINATION
RESISTOR
J06
GND
J08
P25
ENABLE
FUSE
(10A 58V)
P23
A
B
C
P24
CAP
P10
INTERFACE TO
MAIN HARNESS
P23
E-REELS CAN
DIAG PORT
P16
PROTECTION
DIODE

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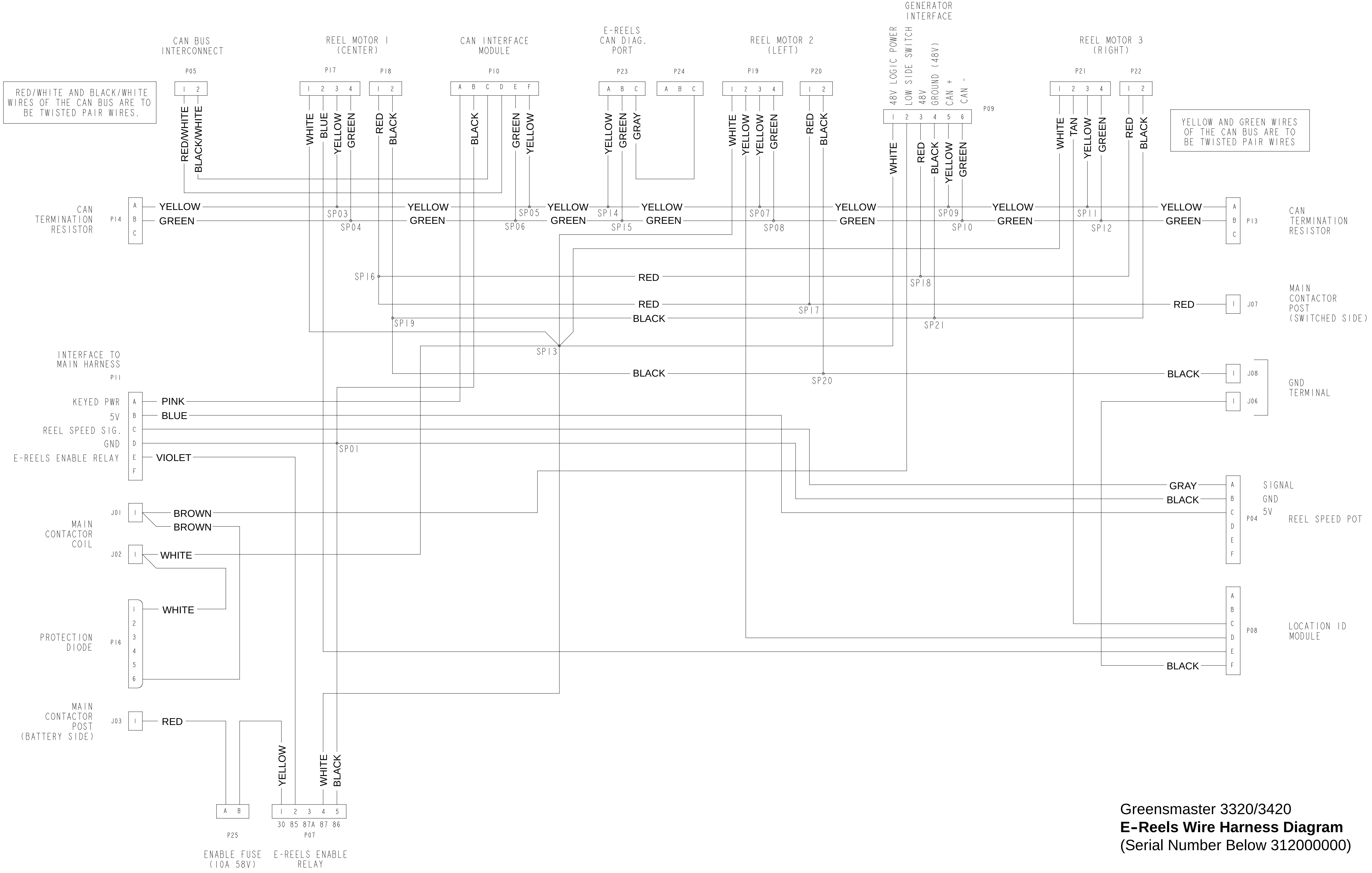
E–Reels Wire Harness Drawing

(Serial Number Below 312000000)


RED/WHITE AND BLACK/WHITE WIRES OF THE CAN BUS ARE TO BE TWISTED PAIR WIRES.
YELLOW AND GREEN WIRES OF THE CAN BUS ARE TO BE TWISTED PAIR WIRES
CAN BUS INTERCONNECT
P05
1 2
RED/WHITE
BLACK/WHITE
REEL MOTOR 1 (CENTER)
P17
1 2 3 4
WHITE
BLUE
YELLOW
GREEN
P18
1 2
RED
BLACK
CAN INTERFACE MODULE
P10
A B C D E F
BLACK
GREEN
YELLOW
E-REELS CAN DIAG. PORT
P23
A B C
YELLOW
GREEN
GRAY
P24
A B C
REEL MOTOR 2 (LEFT)
P19
1 2 3 4
WHITE
YELLOW
YELLOW
GREEN
P20
1 2
RED
BLACK
GENERATOR INTERFACE
48V LOGIC POWER
LOW SIDE SWITCH
48V
GROUND (48V)
CAN +
CAN -
P09
1 2 3 4 5 6
WHITE
RED
BLACK
YELLOW
GREEN
REEL MOTOR 3 (RIGHT)
P21
1 2 3 4
WHITE
TAN
YELLOW
GREEN
P22
1 2
RED
BLACK
CAN TERMINATION RESISTOR
P14
A B C
YELLOW
GREEN
SP03
SP04
SP05
SP06
SP14
SP15
SP07
SP08
SP09
SP10
SP11
SP12
CAN TERMINATION RESISTOR
P13
A B C
SP16
RED
SP18
RED
SP17
RED
J07
1
MAIN CONTACTOR POST (SWITCHED SIDE)
SP19
BLACK
SP21
SP13
INTERFACE TO MAIN HARNESS
P11
BLACK
SP20
BLACK
J08
1
GND TERMINAL
J06
1
KEYED PWR
5V
REEL SPEED SIG.
GND
E-REELS ENABLE RELAY
A B C D E F
PINK
BLUE
VIOLET
SP01
GRAY
BLACK
SIGNAL
GND
5V
P04
REEL SPEED POT
A B C D E F
MAIN CONTACTOR COIL
J01
1
BROWN
BROWN
J02
1
WHITE
WHITE
PROTECTION DIODE
P16
1 2 3 4 5 6
LOCATION ID MODULE
P08
A B C D E F
BLACK
MAIN CONTACTOR POST (BATTERY SIDE)
J03
1
RED
YELLOW
WHITE
BLACK
A B
P25
ENABLE FUSE (10A 58V)
1 2 3 4 5
30 85 87A 87 86
P07
E-REELS ENABLE RELAY

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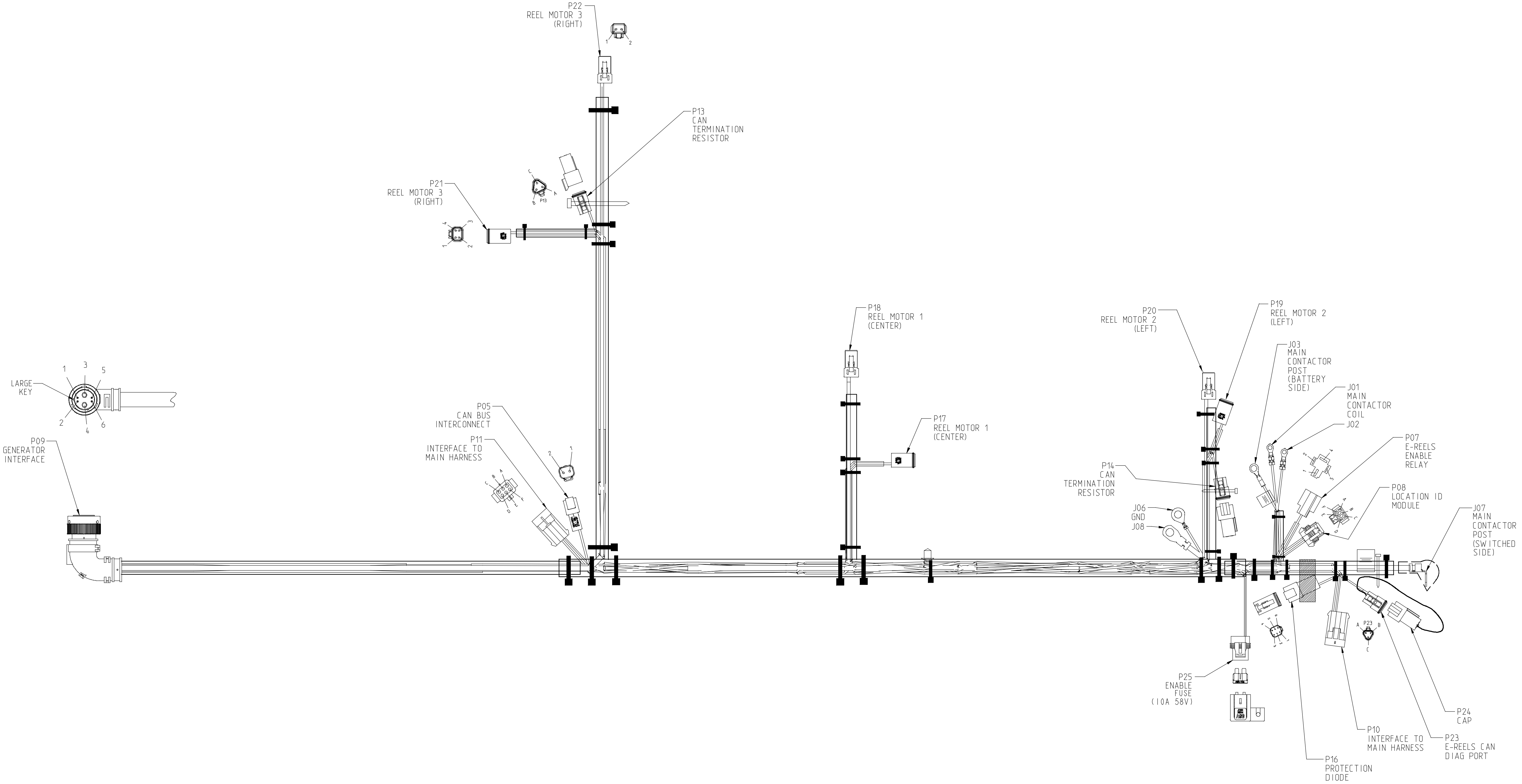
E–Reels Wire Harness Diagram

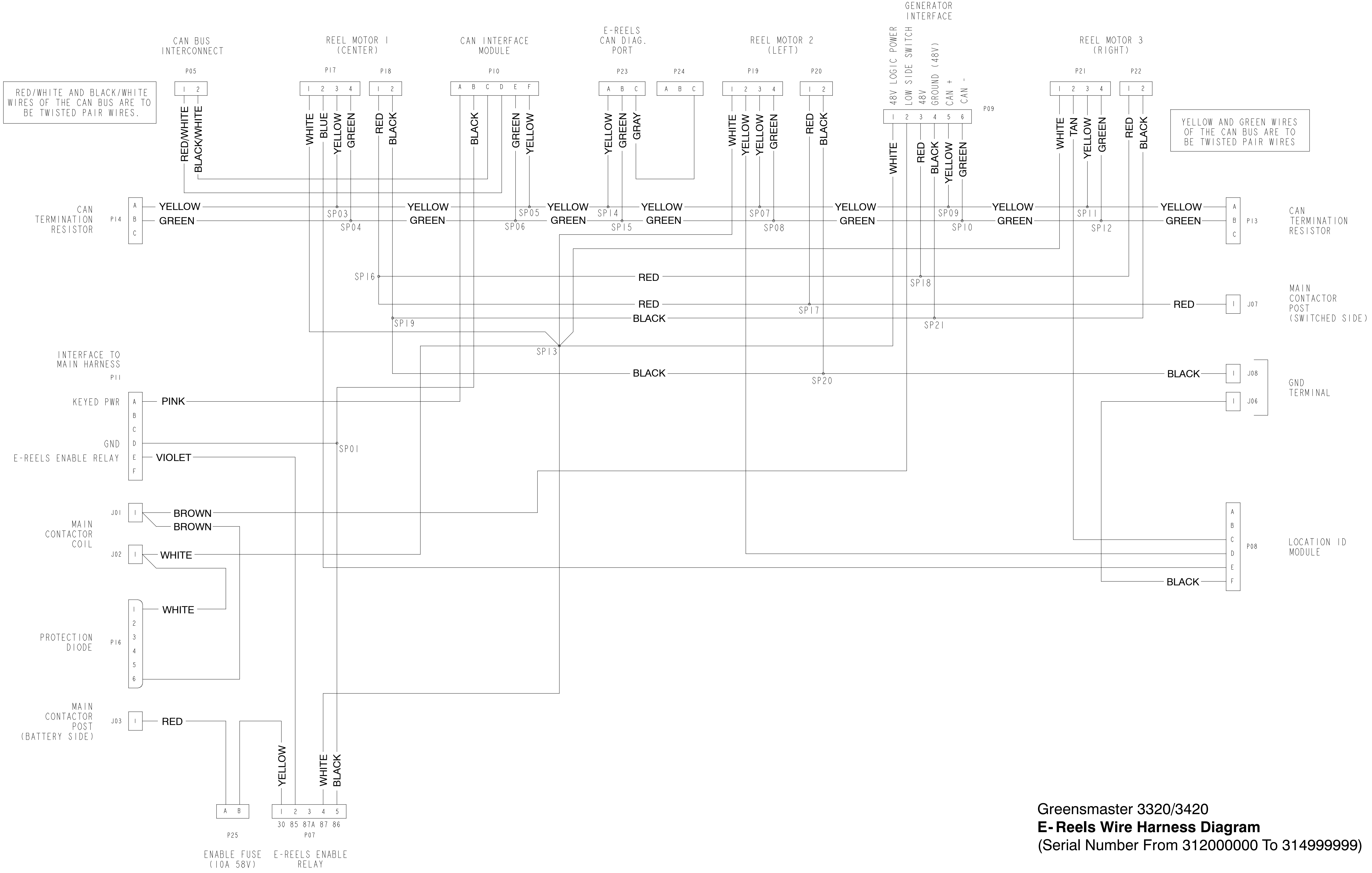
(Serial Number Below 312000000)


P22
REEL MOTOR 3
(RIGHT)
P13
CAN
TERMINATION
RESISTOR
P21
REEL MOTOR 3
(RIGHT)
P18
REEL MOTOR 1
(CENTER)
P17
REEL MOTOR 1
(CENTER)
P20
REEL MOTOR 2
(LEFT)
P19
REEL MOTOR 2
(LEFT)
J03
MAIN
CONTACTOR
POST
(BATTERY
SIDE)
J01
MAIN
CONTACTOR
COIL
J02
P07
E-REELS
ENABLE
RELAY
P08
LOCATION ID
MODULE
J07
MAIN
CONTACTOR
POST
(SWITCHED
SIDE)
LARGE
KEY
1
3
5
2
4
6
P09
GENERATOR
INTERFACE
P05
CAN BUS
INTERCONNECT
P11
INTERFACE TO
MAIN HARNESS
P14
CAN
TERMINATION
RESISTOR
J06
GND
J08
P25
ENABLE
FUSE
(10A 58V)
P24
CAP
P10
INTERFACE TO
MAIN HARNESS
P23
E-REELS CAN
DIAG PORT
P16
PROTECTION
DIODE

Greensmaster 3320/3420

E- Reels Wire Harness Drawing

(Serial Number From 312000000 To 314999999)


RED/WHITE AND BLACK/WHITE WIRES OF THE CAN BUS ARE TO BE TWISTED PAIR WIRES.
YELLOW AND GREEN WIRES OF THE CAN BUS ARE TO BE TWISTED PAIR WIRES
CAN BUS INTERCONNECT
P05
RED/WHITE
BLACK/WHITE
REEL MOTOR 1 (CENTER)
P17
WHITE
BLUE
YELLOW
GREEN
P18
RED
BLACK
CAN INTERFACE MODULE
P10
A B C D E F
E-REELS CAN DIAG. PORT
P23
P24
GRAY
REEL MOTOR 2 (LEFT)
P19
P20
GENERATOR INTERFACE
P09
48V LOGIC POWER
LOW SIDE SWITCH
48V
GROUND (48V)
CAN +
CAN -
REEL MOTOR 3 (RIGHT)
P21
P22
TAN
CAN TERMINATION RESISTOR
P14
P13
SP03
SP04
SP05
SP06
SP07
SP08
SP09
SP10
SP11
SP12
SP13
SP14
SP15
SP16
SP17
SP18
SP19
SP20
SP21
SP01
MAIN CONTACTOR POST (SWITCHED SIDE)
J07
GND TERMINAL
J08
J06
INTERFACE TO MAIN HARNESS
P11
KEYED PWR
PINK
GND
E-REELS ENABLE RELAY
VIOLET
MAIN CONTACTOR COIL
J01
BROWN
J02
WHITE
PROTECTION DIODE
P16
MAIN CONTACTOR POST (BATTERY SIDE)
J03
RED
LOCATION ID MODULE
P08
BLACK
P25
ENABLE FUSE (10A 58V)
P07
30 85 87A 87 86
E-REELS ENABLE RELAY

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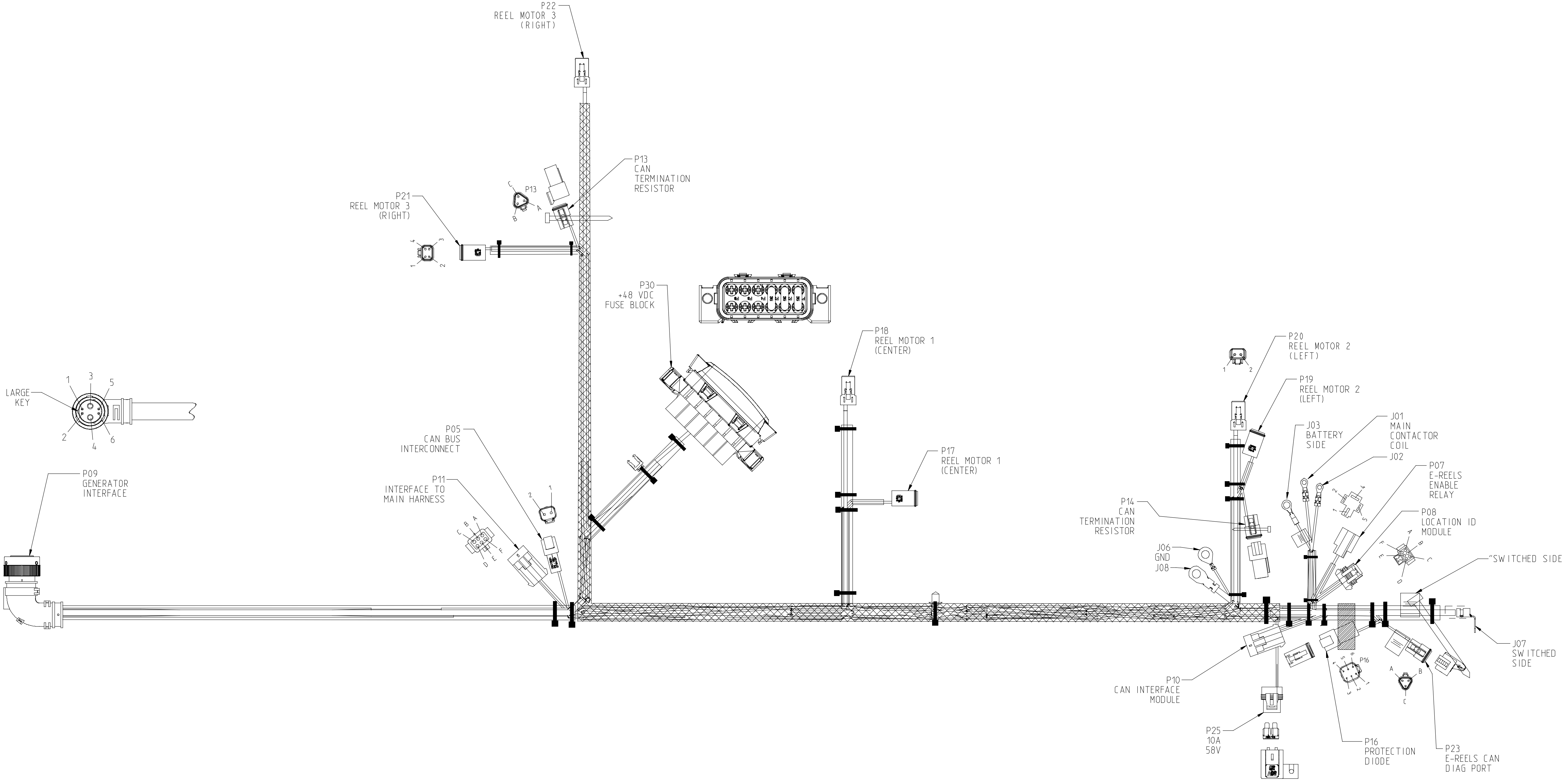
E-Reels Wire Harness Diagram

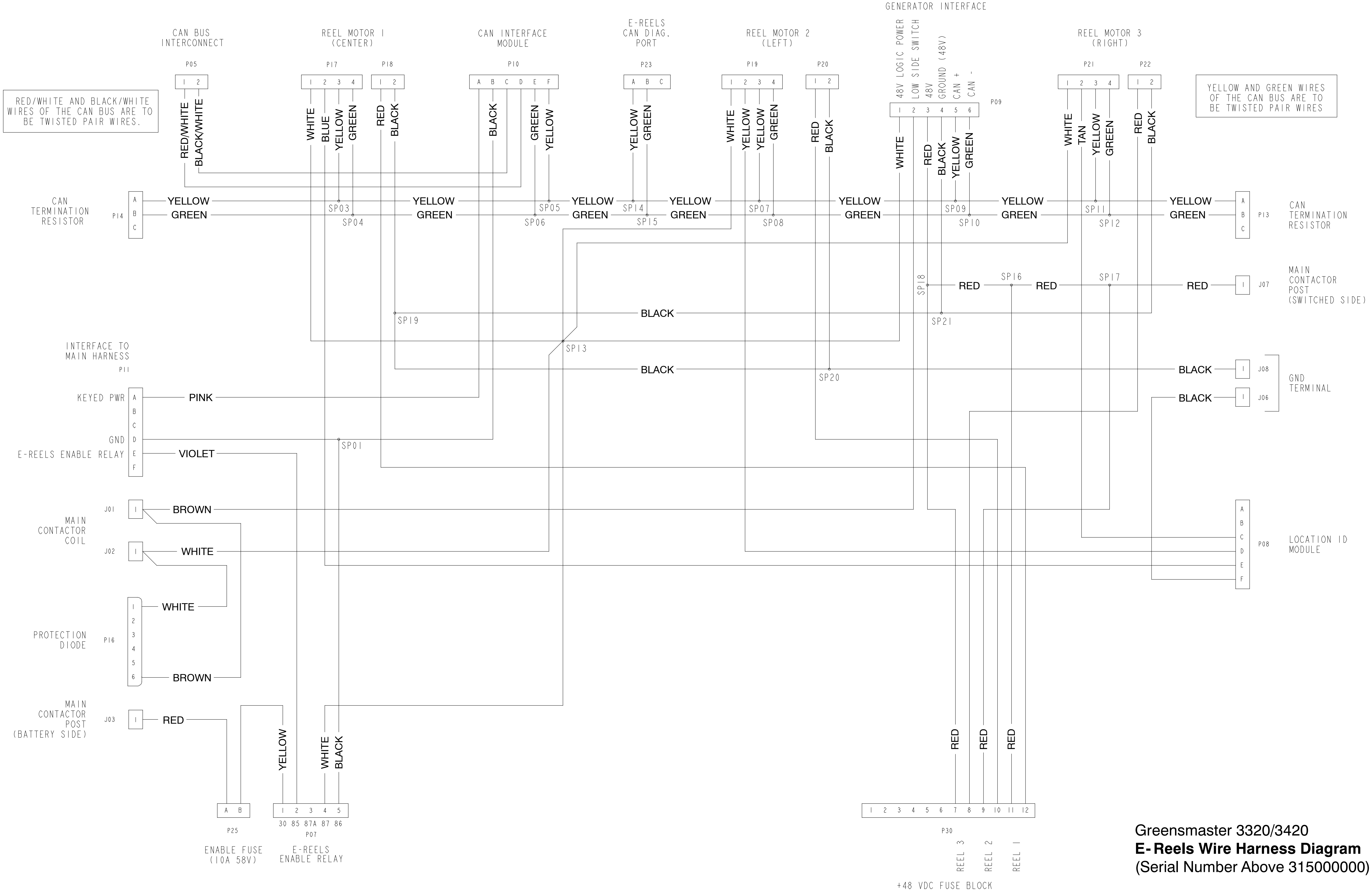
(Serial Number From 312000000 To 314999999)


P22
REEL MOTOR 3
(RIGHT)
P13
CAN
TERMINATION
RESISTOR
P13
C
A
B
P21
REEL MOTOR 3
(RIGHT)
4
3
1
2
P30
+48 VDC
FUSE BLOCK
P18
REEL MOTOR 1
(CENTER)
P20
REEL MOTOR 2
(LEFT)
1
2
P19
REEL MOTOR 2
(LEFT)
LARGE
KEY
1
3
5
2
4
6
P05
CAN BUS
INTERCONNECT
P11
INTERFACE TO
MAIN HARNESS
C
B
A
D
E
F
2
1
P09
GENERATOR
INTERFACE
P17
REEL MOTOR 1
(CENTER)
J03
BATTERY
SIDE
J01
MAIN
CONTACTOR
COIL
J02
P07
E-REELS
ENABLE
RELAY
P14
CAN
TERMINATION
RESISTOR
P08
LOCATION ID
MODULE
J06
GND
J08
"SWITCHED SIDE"
J07
SWITCHED
SIDE
P10
CAN INTERFACE
MODULE
P16
A
B
C
P25
10A
58V
P16
PROTECTION
DIODE
P23
E-REELS CAN
DIAG PORT

Greensmaster 3320/3420

E-Reels Wire Harness Drawing

(Serial Number Above 315000000)


CAN BUS INTERCONNECT
P05
REEL MOTOR 1 (CENTER)
P17
P18
CAN INTERFACE MODULE
P10
E-REELS CAN DIAG. PORT
P23
REEL MOTOR 2 (LEFT)
P19
P20
GENERATOR INTERFACE
48V LOGIC POWER
LOW SIDE SWITCH
48V
GROUND (48V)
CAN +
CAN -
P09
REEL MOTOR 3 (RIGHT)
P21
P22
RED/WHITE AND BLACK/WHITE WIRES OF THE CAN BUS ARE TO BE TWISTED PAIR WIRES.
YELLOW AND GREEN WIRES OF THE CAN BUS ARE TO BE TWISTED PAIR WIRES
RED/WHITE
BLACK/WHITE
WHITE
BLUE
YELLOW
GREEN
RED
BLACK
TAN
CAN TERMINATION RESISTOR
P14
P13
SP03
SP04
SP05
SP06
SP07
SP08
SP09
SP10
SP11
SP12
SP13
SP14
SP15
SP16
SP17
SP18
SP19
SP20
SP21
SP01
MAIN CONTACTOR POST (SWITCHED SIDE)
J07
INTERFACE TO MAIN HARNESS
P11
KEYED PWR
GND
E-REELS ENABLE RELAY
PINK
VIOLET
GND TERMINAL
J08
J06
MAIN CONTACTOR COIL
J01
J02
BROWN
LOCATION ID MODULE
P08
PROTECTION DIODE
P16
MAIN CONTACTOR POST (BATTERY SIDE)
J03
P25
ENABLE FUSE (10A 58V)
30 85 87A 87 86
P07
E-REELS ENABLE RELAY
P30
REEL 3
REEL 2
REEL 1
+48 VDC FUSE BLOCK

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E-Reels Wire Harness Diagram

(Serial Number Above 315000000)

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